baader planetarium®

GENERAL INFORMATION

THE PURPOSE OF THE BAADER PLANETARIUM

by Claus Baader

Due to the schooling and space travel, nearly everyone knows that our solar system is of a **heliocentric nature**. That means the earth and all other planets orbit a **centrally positioned sun**. We also know that the moon orbits around the earth; at the same time both - earth and moon - revolve around the sun. We are all familiar with the mechanics of day and night. However, this is as far as our imagination reaches for most of us. Additional celestial relationships usually find us at a loss. A model was needed to show the mechanics of nature in miniature scale and at the same time place this unit at the disposal of every interested person. The **BAADER PLANETARIUM** has succeeded in meeting these conditions for everyone desiring a visual explanation of the many complex celestial relationships. It now becomes **possible to see the mechanics of the heavens in progress** and allows the viewer to imagine himself onto the small model earth. Thereby the viewer is able to see the occurency of many phenomena with an accuracy unknown up to now.

A major advantage of the **BAADER PLANETARIUM** is therefore the visual **apprehension** made possible. Anyone who spends some time and thought with the unit will acquire such a lasting impression of the celestial relationships, that whenever particular questions appear, it will become quite easy to explain these points on the basis of a clear understanding previously acquired. The fact that the **BAADER PLANETARIUM** is a miniature scale model of our solar system assures us that a wrong demonstration is impossible. Only the scale or speed of the demonstration differ from nature - an effect that's very useful for to save time for demonstrations.

The **BAADER PLANETARIUM** therefore seeks to explain the celestial relationships in an attractive way to the novice, as well as **explaining the geocentric (Ptolemaic) terminology** used for many reasons in the scientific world. Up to now, astronomers have **been forced to take most measurements from the earth** - therefore causing the novice to feel that the earth is stationary, when making observations. (i.e. **“the stars move across the sky”**). Thus, the novice, student, or any individual looking for an explanation, is often confused and looses the necessary apprehension. Knowing that the earth is not stationary, but being forced to think and measure in such terms, naturally causes complex difficulties. The understanding that the **BAADER PLANETARIUM** can give in this context, is of major consequence. Once it is understood, for example how North America. on the small model earth moves in a tilted manner in space (due to the tilted axis of earth related to the earth's orbit around the sun, the ecliptic), it will become obvious why the stars change their relative position to that of the observer not only in the duration of one night, but also additional in the duration of one year. Similarly, it becomes possible to see why the “stars move across the sky” during one night.

DISTANCE AND SIZE RELATIONSHIPS

We now know that the size relationships found in space are infinitely large **and appear to lie outside the imagination of man**. We must measure distance in space – even for our immediate vicinity – in light years (1 light year = approx. 9460 800 000 000 km), in order to facilitate some kind of description. We all know that interplanetary vehicles, traveling from earth to one of our solar planets (such as Venus or Mars), require several months to reach their destination – moving with a speed greater than 40.000 km. The size of the planets and distance involved will explain why the scale found in the

BAADER PLANETARIUM cannot be completely true-to-nature. Similarly, the relative size of the sun and the small model earth had to be compensated. With a model earth having a 35 mm diameter, the sun would have to be about **one-hundred times as large, what is about 3,5 meters**. Someone calling for a true-scale-model only shows that he does not comprehend the dimensions found in space. However, the size relationships of the two celestial bodies – Moon and Earth – are true-to-scale in the **BAADER PLANETARIUM**.

Of little importance is the fact that the wire models of the planets Mercury, Venus and Mars are stationary in the **BAADER PLANETARIUM**. The required mechanical apparatus to show their movement would not be justified by the demonstration thus made possible. The important concept shown by the planets is the location of the orbital paths in space. lt is the common plane of the orbits that called for a visual demonstration. Therefore it becomes easy to explain that the direction of all motion in our solar system is similar and that the orbital paths found in the system all have the same direction.

Just as it is unpractical to attempt a true-scale model of our solar system , it would be futile to show the moon and its natural orbital inclination to the earth. **It was therefore necessary to show the angular position of the moon's orbit compared to the earth somewhat exaggerated**, thereby showing the phenomena of **a full moon and eclipses in the model solar system. The revolutions of the earth and moon were reduced**, so as to permit clear observation of the continents during demonstration. These **necessary reductions** were carried out in a manner causing the earth to rotate once in a month-meaning that the year has a duration of twelve days (one month has one day). The moon shows three synodic orbits during that time, with the earth orbiting the sun in about four minutes. Therefore one year lasts about four minutes in the **BAADER PLANETARIUM** (during slow operation), although the model earth may be speeded up to bring it into any desired position.

DEMONSTRATION OF THE BAADER PLANETARIUM

IMPORTANT! When operating the unit, be sure that the plane of the earth's orbit is horizontal. (This gives the observer the feeling of a reference plane to his environment seeming to be always horizontal.)

THE CELESTIAL GLOBE

Before beginning the demonstration, the observer should see the closed sphere of the planetarium under direct light. The sphere appears opaque and has the properties of a celestial globe, enabling the viewer to study the major constellations in a manner similar to conventional globes. **At this point it should be made clear that all celestial Globes viewed from the outside present the heavens in reverse order**. This drawback is caused by the fact that man sees the natural heavens as an arched firmament, whereas the celestial globe observed from the outside necessarily shows the same image in reverse order.

THE SUN AS LIGHT SOURCE

Now turning on the small, artificial sun on the inside of the **BAADER PLANETARIUM** will bring about an amazing effect. In a **somewhat darkened room**, the previously opaque sphere becomes transparent, and it is possible to look into the sphere from all sides. In cases where it is impossible to reduce the illumination of the demonstration room, the observer must only approach the sphere very closely (shielding off any infalling light from the side with his hands), in order to see the inside of the once opaque celestial globe. It should be pointed out that this effect **enables** the observer to see the stars on a black sky and in a unique true-to-nature manner found only in the **BAADER PLANETARIUM**. The observer has the feeling as if he were **actually looking up into the heavens at night** – seeing the stars on an **arched, black firmament and in their correct perspective**.

REMOVING THE GLOBES TOP HALF

Now the various demonstrations should be started. The top (northern) half of the sphere can be removed to facilitate the first explanation. The observer now sees the solar sys tem in space, and it should be made clear at this point, the small lamp in the center represents our sun. The two inner wire orbital paths represent the planets MERCURY (requiring 88 days for one revolution around the sun), and VENUS (requiring 225 days for one revolution). The third planet from the sun is our EARTH, which is seen with its moon as a moveable model. Fastened to the lower half of the sphere is a wire orbital path of the

fourth planet in our solar system - that being MARS (requiring 687 days for one revolution around the sun).

PLANE OF ORBITS

With the sphere being open, it is easy to explain the position and the similar plane of the planets as they move around the sun. These observations can be made easily by comparing the wire orbits and the model earth. The observer should now be told that the orbit of the exterior planets JUPITER, SATURN, URANUS, NEPTUNE and PLUTO, as well as the planetoid (asteroid) belt, are printed on the inside surface of the sphere. It should also be noted that these illustrated orbits continue on the top half of the sphere (previously removed), and that this clearly shows the relative plane and position of the planet. All the planets therefore **are seen to be lying in one plane**, the only exception being the planet PLUTO. Scientists are led to believe that the planet PLUTO is under the influence of unknown gravitational forces, having an influence on its path around the sun.

DIRECTION OF ORBITS

The next step in a demonstration is the explanation that all big orbits found in our solar system have the same direction. To observe that phenomenon, we must choose a reference point for our observation, that being the north or top of the sphere. Looking down into the planetarium from that point, we note that the earth rotates on its axis in a counter clockwise fashion. Similariy, the moon moves counterclockwise in its orbit around the earth. The earth also moves conterclockwise around the sun in completing one year, just as all orbital movement of the other 8 planets is in that same direction in our solar system. This phenomenon is consequently a strong evidence for the theory stating that our solar system evolved out of a gyrating mass of gases. That theory assumes that intergalactic gases were brought to a rotating motion due to some gravitational forces, increasing in density and speed over time. That process led to the formation of “solid” bodies revolving around a condensation center – that being our sun. This theory on the formation of our solar system is quite feasible and has found wide acceptance today.

SUN’S LIGHT ON EARTH

Continuing the demonstration, the illumination phases of the earth making up one year during its revolution around the sun should be explained. Whether the planetarium should be closed (top half again placed on the planetarium) for further study depends on the particular demonstration and how well the room can be darkened. With the sphere closed, it is easier to shield off infalling light, and the observer will more easily see the various phases during the demonstration.

TILT OF EARTHIS AXIS

It must be pointed out that the rotation of the earth around its own axis results in a gyrating top-like effect, thereby maintaining its relative position in space. However, the careful observer will note that the north/south axis of the earth is not vertical on its moving path. That means that the earth's axis, relative to its orbit around the sun (ecliptic), has an angular tilt of 23,5°. The **BAADER PLANETARIUM** clearly shows the same phenomenon and the observer is able to see the tilted axis of the earth in its orbit around the sun. When demonstrating this latter effect, it may be helpful to show the whole process by using one’s hand in explaining how the tilted earth revolves around the sun – always keeping its constant tilt. When the observer keeps these principles in mind and watches the small model earth during the orbit around the sun, it becomes quite clear how the **tilted axis of the earth leads to the various phases of sun’s illumination on our planet**.

SEASONS

After having pointed out that the earth’s distance from the sun varies during the course of one year due to the elliptic nature of the orbit, it becomes necessary to explain the nature of the seasons**. The four seasons are only caused by the angular tilt of the earth’s axis** during its orbit around the sun. To demonstrate this phenomenon, we watch the planetarium in operation – looking down into the sphere from the north. We note that the small model earth orbits the sun in a counterclockwise direction, **completely illuminating the North Pole at one point** (North-America-summer) and resulting the “polar day”. At the opposite point in its orbit, the **North Pole of the earth lies in darkness** (North-America-winter), causing the “polar night”. Attention should be cal led to the fact that **in winter, North-America passes through a short daylightzone**, with night being long. In contrast, these **conditions are**

reversed on the oppoite side of the earth is solar orbit – a is the case in the month of June. The night zone that the continent of North-America experiences darkness is much smaller (a short summer-night). In turn, the distance traversed during daylight is now very long and sunrise occurs as early as four o'clock in the morning. An explanation should stress the fact that **the length of night and day is not the determinant for summer**, but that **the angularity of the sun's illumination has the major influence**. When observing the earth's northern hemisphere during winter, it will become clear that the angularity of the sun's rays is flat and consequently results in yielding less warmth and intensity, in contrast to the more direct illumination found in summer. During that season, the rays of the sun fall more directly and therefore with greater intensity upon North-American latitudes. From experience everyone knows that during winter the sun stays near our visual horizon. During summer, the sun passes more directly over us at maximal zenith. (Attention is called to the fact, that this demonstration will only succeed if the support of the earth and sun has been aligned according to the provided instructions. The graduation of latitude and longitude on the earth must be parallel with the graduation found on the outside of the sphere. The celestial equator and that of the model earth must lie in parallel planes).

LIGHT PHASES OF THE MOON

Continuing the demonstration, the occurrence and **visibility** of the lunar phases must be explained. Again the observer is required to imagine himself on one particular spot on the model earth, looking upward into the heavens from that location. The moon's phases will be seen when looking in a direct line over the earth and toward the moon. When watching lunar phases, it is quite instructive to point out the occurrence of a new moon or one in its last quarter. For the more advanced, the demonstration may include a visual presentation of the moon when "lying on its back".

It is quite obvious that when watching the phases of the moon, **the whole sphere may be turned**, giving the observer a good view of the involved relationships. Lunar eclipses and periods of a full moon take place independently during the moon's orbit of the model earth. Following an occurrence of a lunar eclipse, it will prove practical to explain the reasons for a new moon. A new moon means, that the moon is positioned exactly on a imaginary line between the earth and the sun. Consequently, the visible side of the moon is obscured and cannot be seen for one night. It is curious that everyone knows the term "new moon", but that 99 out of 100 persons are at a loss as to where the moon is actually located at that time. (The concept "new moon", is often confused with that of a lunar eclipse.)

SOLAR ECLIPSE

Having shown the principle of the new moon, another most attractive demonstration becomes possible – that of a **solar eclipse**. It is here that the shadow of moon can be watched easily as it passes over the surface of the earth. We are able to **demonstrate the occurrence of a solar eclipse** on earth, also **showing the zone of total darkness** (umbra) and those under a **partial eclipse** (Penumbra). The complex changing motion of the **BAADER PLANETARIUM** permits an explanation why some solar eclipses cover a large area of our earth, while others include only relatively small locations. Such phenomena are given a clear explanation by the visible orbital path of the moon (i.e. chrome supporting ring), relative to the position of the earth this chrome ring has it's own clockwise motion showing the changing of the lunar nodes.

DAY AND NIGHT

Showing these complicated light effects of the sun and the earth, another major point must not be overlooked. Every observer understands that day and night is caused by the sun illuminating one side of the earth, while the opposite side is in darkness. In giving this explanation to the observer, we must be aware of the fact that not only the length of the days change, but that our revolution around the sun necessarily brings constantly different sections of the heavens into our view at night. For the first time the observer or student really receives a visible explanation why different sections of the starry sky become visible during the course of one year. At the same time, the observer sees how the small earth moves past one section of the sky, while rotating on its axis during the period of one night. From these insights, **one quickly comprehends why the stars seem to "move across the sky" at night**. With some advanced understanding, it will also become clear why the angles (i.e. "shooting the stars") to the stars, as measured from the earth, constantly change during the year and during one single night.

SUNS'S MOVEMENT IN THE MILKYWAY

After completing the above demonstrations showing the multitude of light relationship, it will be appropriate to show the observer another perplexing demonstration made possible by **the BAADER PLANETARIUM**. Taking the whole sphere into your hands (grasp the North and South Pole, preventing the planetarium to pop open), we can demonstrate the fact that while all these movements of our solar system are taking place in space**, our sun and all its planets are similarly moving around the galactic center**. This revolution is completed in about every 200 million years. With the sphere held up, we can describe a large circle, indicating this 200 million year orbit.

In addition, turning the sphere to face the observer horizontally with its North Pole, we are pointing out that the position of our solar system in space is a firm one, but – relative – while, with **a BAADER PLANETARIUM**, the observer can change his point of observation as desired. Moreover, it would be a mistake – following our subjective feeling – to think that our solar system is positioned horizontally in space. There is no up-or-down in space. A position depends only on the reference point used by the oberserver or on the observer's direction of view. Were a spaceship located on a solar orbit at a point near the polestar, the astronauts would observe our solar system, seeing the earth coming up on one side of the sun and descending on the other. (Similar phenomena we observe by telescopes, looking to far galaxies in deep sky. We observe them always from different sides.)

MOONS MOTION

From that same "polestar location", the relativity of the moon's motion could be clearly observed. The moon describes a weak elliptic orbit around the earth. **That same orbit – seen in relation to the sun – has a totally different nature when compared to the sun.** An effort should be made to show this phenomenon to the observer. **Looking at the moon in it's relation to the sun** more closely, we see that it describes an orbit which heads directly for the sun, then seems to stop for some time, only to move away from the sun and then to overtake the earth in its own orbit around the sun. The moon describes a motion not completely duplicated in a small scale model, since the relative velocity of earth and moon is total different to nature.

EARTH'S NORTHERN AND SOUTHERN HALF

Another amazing demonstration with the **BAADER PLANETARIUM** calls for the selection of a particular reference point. Previously it was mentioned that we are to look down into the solar system of our planetarium from the north, seeing all motion in space in a counterclockwise direction. The observer must only imagine himself onto the northern hemisphere of the model earth, and from there he must look upward toward the sun. It will become obvious how the sun rises in the east, is positioned in the south at noon and sets in the West. Having observed the latter principle, we go on with a further demonstration. Turning the whole sphere upside down (the sun-arth support should now face upward), causing the South-Pole to be on the top, the observer will be amazed to see that all motion is reversed – that now being a clockwise direction. Repeating both demonstrations – once watching from the North-Pole and then from the South-Pole – we note that **the direction of all orbital motion changes at the equator**. Again the **BAADER PLANETARIUM** has managed to duplicate the process found in nature. That phenomenon can be observed on any extended air or sea trip across the equator. For in the southern hemisphere the noon sun is seen in the north and moves in an opposite direction – much to the confusion of visiting Europeans or North-Americans. The observer only needs to imagine himself onto the southern hemisphere of the model earth, seeing why the sun moves in a counterclockwise direction across the sky and appears in the north at midday.

THE CLEVER GLOBE-CONCEPT

Before turning to the projection part of the demonstration, it may be fun to show the observer the unique design of the plastic sphere. Two people looking into the sphere from opposite sides can observe the interior, but **will not be able to see each other through the sphere**. Demonstrate this quality by looking into the planetarium from one side, and have the observer look into the sphere from the side opposite. The reason for this trait is that the plastic used to manufacture the sphere absorbs about 95% of all light, being translucent to only the remaining 5%. Consequently, when we look into the sphere in a darkened room, we receive only 5% of the visible light, with absorbtion and reflection causing the opposite inside surface of the sphere to appear as an arched and black sky.

PROJECTION CAPABILITIES

Following the demonstration procedure, it now is advisable to present the projection capabilities of the **BAADER PLANETARIUM**. We show the observer **how the sun cover may be pulled off**, laying barea small light bulb producing a pointlike source of light. That concentrated light source permits projection of shadows or a “negative”, projection of the stars, connecting lines, as well as the graduation of latitude and longitude onto ceiling and walls. It will be useful to explain the various constellations – whereby a pencil or pointer used to show these individual stars will also be projected onto the ceiling. In addition, the **foil diagrams** (previously cut out - see instruction manual) are placed on the sphere**, projecting their image onto the ceiling** . As an example, the Big Bear may be projected by placing this constellation near the top of the sphere, thereby reducing any distortion in projection.

ADJUSTATION TO THE SKIES

In carrying out the above demonstration, it should be made clear that we are in the position to project onto the ceiling the night sky for every day of the year. Look into the sphre to where the **ecliptic** – meaning the orbit described by the earth around the sun – becomes visible as **a line depicting the months**. You can now read off a desired month, such as the current one and then **move the small model earth to the middle of that printed month by using the remote control**, stopping the earth at that point. lf the polestar of the sphere is now aligned with the polestar in the sky, and the sphere is turned on its north-south axis by hand until the model earth reaches the highest point in its orbit (consequently the month meridian intersects the highest point of the sphere), then we may instruct the observer that he is seeing the night sky as it would appear on the 15th day of the chosen month at midnight. Further, the night sky previous to or after midnight, may be observed by turning the sphere forward or backward on its north-south axis, adjusting it to the desired hour graduations. To enrich this particular demonstration, reference can be made to the circumpolar stars, i.e. that the Big Dipper “moves around” the polestar during the course of one year. In trying to explain the phenomenon of the “moving of the polestar”, it must be mentioned that the night side of the earth faces different sections of the sky during one revolution around the sun – necessarily resulting in the Big Dipper to change its relation to the pole-star. **Note that** these relationships can be **visually mastered with the BAADER PLANETARIUM**. By stopping the model earth at a particular time of the year, the observer is asked to look from this chosen position at the location of the circumpolar stars, checking out the above relationships, also known as the permanent celestial clock.

THE PROJECTION WITH THE CUPOLA

No matter wether a cupola is already on hand or a prefabricated quick mountable **BAADER-Dome** is available, naturally the demonstration of the projection becomes much more impressive when using a projection-cupola. In that case an accurate adjustment is possible which enables the observer very intensively to understand the changing of the heavens during the year. For using a cupola, the following steps should be taken and made clear.

1. The planetarium has to be placed in the center of the dome in a way that the lamp inside the star globe is in line with the rim of the projection dome. Remove the cover from the lamp! **KEEP IN MIND**: The distance between the **EARTH** and **SUN** is nearly zero compared to the distance to the fixed-stars. For the projection therefore the whole solar system is only a small dot in the center of the star globe. This explains that during one night we permanently see 50% of the skies only, which is the same on the cupola.
2. Now move the model earth to the desired month and stop it in the middle of the section Turn the star globe until the shadow of the earth is seen at the highest point of the dome. Now the meridian is adjusted and it is clear that an observer, standing at the highest point of the little model-earth (i.e. nearest the equator), would exactly see the heaven projected on the cupola.
3. Now adjust your latitude by turning the-star globeuntil **YOUR LOCATION** is the highest point on the little earth. Tilt the starglobe upward or downward but be attentive that the earth’s shadow always remains on an imaginary line through the zenith of the dome. The accurate latitude can be controlled with the help of a small calculation. Deduct your latitude from 90°, the resulting figure then has to meet the rim of the dome as inverted shadow, exactly opposite to the place where the earth’s shadow is positioned. Now you see the heavens for the chosen month and your latitude at 12 o’clock midnight.

4. Additionally every hour the earth rotates counterclockwise 15 degrees. For presenting the heavens for another time of the night therefore turn the globe around its polar axis always 15° for each hour. Counterclockwise for the time before midnight, clockwise for the time after midnight . (Seen from the North).

TECHNICAL SPECIALS

Having completed the projection, the general demonstration may be considered as finished. The following points are directed more towards advanced individuals and professionals in the field.

Mention can be first made of the technical design and construction of the **BAADER PLANETARIUM**. Located in the base, under a box-like protection, a transformer is housed, which works with a rectifier, a step switch, and an adjustible potentiometer, to control and manipulate the movements of the earth and moony as well as varying the intensity of the artificial sun light. The controlled power is **then transferred from the base** into the sphere by a **connecting cable**, where it reaches a current consumer. This current consumer permits the minute motor, propelling the earth and moon to travel around the center support on the inside of the planetarium. That small motor is quite costly, since it is connected with a miniature reduction gear – **bringing the ratio down to permit slowest operating speeds**. The arm supporting the model earth contains a flexible drive shaft, connected to the watch-like gears of the upper mechanism.

That small gear unit controls additional to earth's motion around the sun, four **distinct operations**, due to a design which will amaze the interested observer. The four functions are to:
1) rotate the earth on its axis;
2) orbit the moon around the earth;
3) point the axis of the model earth toward a defined point in space;
4) propel the chrome ring of the moon's orbital path, that being different than all other revolving motion.

The independent motion of the chrome ring supporting the moon shows the changes of the lunar nodes, as well as visually demonstrating the relative position of the moon's path in regard to the earth. Those observers with a technical background will be interested to learn that the gears contain a four-fold coaxial driveshaft, meaning that four self-contained, minute tubes are responsible for the individual motions achieved. The fact that the lunar and solar eclipses occur at different cycles is due to the circumstance, that the position of the moon's orbit also changes the moon's shadow on the earth.

The design of these gears is further responsible for showing the formation of **sideral and synodic time**. The **BAADER PLANETARIUM** therefore permits demonstration of the sideral, synodic, and draconitic months. The concept of sideral and synodic time is adequately covered in the instruction manual. By counting the revolutions in reference to the sun (synodic time) , and then repeating this process by counting toward a star (sideral time) for a second time, the observer will see that the small gears produce 12 synodic and 12 sideral days. The occurrence of sideral and synodic time is caused by the fact that – while these are counted – the earth is also finishing one complete orbit of the sun. You will find an example of this explanation in the instruction manual.

When orbiting the earth, the moon causes a similar phenomenon**, which science describes as sideral and synodic months**. In addition, the gears causing a change in the moon's path permit the demonstration of the draconitic month.

DEMONSTRATIONS FOR THE ADVANCED STUDENT

Lastly, a demonstration of the **Platonic year** is made possible with the **BAADER PLANETARIUM**. The observer should be told that the sun has an influence on the position of the earth's axis (Straightening its angular tilt), by its **gravitational forces**. The earth in turn has a precession of the equinoxes, with that complete revolution having a cycle of 26.000 years, and being known as the Platonic or great year. In that process, the earth counters the gravitational influence of the sun (lunisolar precession) by carrying out a precession motion (clockwise from the north) against the direction of its rotation (counterclockwise from the north) . By carefully grasping the lower sun-earth support, and rotating it once in a clockwise direction, we are thereby demonstrating a complete **precession cycle of 26.000 years**. In that latter demonstration, the line depicting the months would equal a time span of 2.150 years for each monthly division.

By turning the inside support in such a manner, we see how the ancient Babylonians and Greeks observed a different starry sky during a particular season when compared to our time. With the **BAADER**

PLANETARIUM you can therefore show how the heavens appeared during Roman times, for example, such as at the birth of Christ. This demonstration was previously possible only with full sized planetariums, and comment should be made, that spring on earth does not start when the earth is on the "spring side" of the sun, that being under the sign of the Fishes. Because of our earth centered view to the heavens, we put the beginning of spring at the vernal equinox, or the point where the sun's center crosses the spring point. This same reason is responsible for such astronomical terminology as "the sun passes along the ecliptic". The **BAADER PLANETARIUM** will again point out the natural occurrence of events, showing that the earth revolves around the sun in one year **– leading to the belief that the sun has made a similar motion on the ecliptic**. The precession motion of the earth is connected with the fact, that the sun would have to be under the sign of the Ram on March 21st, according to general custom. But, due to the precession and the gyrating, top – like effect of the earth's axis, **we now see the sun at the onset of spring between the signs of Water Bearer and the Fishes. This latter effect is called the "changing of the equinoxes".**

Even with this explanation of precession, several points remain to be discussed shortly. For example, we may say that the orbit of a man-made satellite remains constant in space, once it has reached the target trajectory path. The model polar satellite orbit in the **BAADER PLANETARIUM** permits the earth to rotate under that orbit, enabling the satellite to observe or "photograph" the entire earth several times. With binoculars we are in a position to watch the light phases of VENUS. Now, **the BAADER PLANETARIUM** is giving insight into why we see VENUS sometimes as a morning-, and at other times as an evening star. The nature of the MARS orbit enables us to observe the northern, or at other times the southern pole of MARS, and explains why each of these poles in turn becomes more easily visible to the human observer equipped with a telescope. In addition, the movements of the planetarium's moon will explain why we see 6% more than one-half of the moon's surface. That phenomenon is due to the inclination of the moon's orbit in regard to the orbital path of the earth. "We sometimes see the moon more from the top and at other times more from the bottom". When demonstrating the projection features of the planetarium on a ceiling, we can point out the difficulties of map projection, since we are projecting a grid onto a flat surface. In addition, we should mention that the adjusting of the sphere to the polestar in the sky gives the observer a great deal of insight into the natural relationships. The observer can now apply and compare reality with the model.

Should it prove that our demonstrations have enriched the imagination and the understanding of the observers participating, we can be pleased in having brought these individuals a step closer to meeting the demands of our space age society. With the above instructions for a stimulating demonstration, the **BAADER PLANETARIUM** will be appreciated for its uniqueness and its multitude uses.

baader planetarium®

BAADER PLANETARIUM GMBH

Zur Sternwarte • 82291 Mammendorf • Tel. 08145/8802 • Fax 08145/8805
www.baader-planetarium.de • service@baader-planetarium.de • www.celestron.de