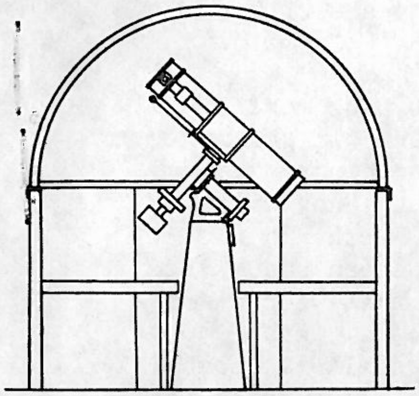

The Spectrum

DECEMBER 1967

BUFFALO ASTRONOMICAL ASSOCIATION INC.
BUFFALO MUSEUM OF SCIENCE
HUMBOLDT PARKWAY
BUFFALO NEW YORK 14211

DECEMBER MEETING: Traditionally the tone of our December meeting (December 8, 1967, at 8:00 PM) turns toward the lighter side. This year we have planned a double feature. In a more serious vein, Mrs. Olga Lindberg (assisted by Ed Lindberg) will present "MARIA MITCHELL AND NANTUCKET ISLAND." Maria Mitchell (1818-1889) is generally considered to have been the first American woman astronomer. The Lindbergs brought back many color slides from their visit to Nantucket Island, some of which they will use as illustrations for their presentation. For our second feature we will have the annual fun show "Star Nights You Wished You Had Missed Because You Were Caught In The Act" by Edith Geiger. Seriously, Edith's humerous and witty accounts of the summer's Star Nights (generously illustrated, of course) have become perennial favorites with our membership. DON'T MISS THIS PROGRAM!! Also, please remember your dues!! Refreshments with a holiday flavor will be served!!

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* THOUGHTS ON ASTRONOMICAL MAGNITUDES. * By Ed Lindberg.

The universe is much bigger than we are able to imagine. Study helps us get a better picture of it but our minds are not able to deal with the large magnitudes involved. Psychologists tell us that our minds cannot picture a number greater than a hundred thousand. As an exercise in visualizing large numbers, take a look at the inch marks on a yardstick. How far would the stick reach if it were a million inches long? Don't figure anything out with paper and pencil or mentally. Just picture, if you can, a million inches laid in a row. Near what point in your locality would the other end lie? Then figure it out in terms of miles by simple arithmetic and you may begin to agree with the psychologists.

It is when we study astronomy that we encounter big numbers. The solar system is about 8 billion miles in diameter and large though this number is, it is small compared to interstellar distances. The nearest star is about 4 light years or nearly 24 million million miles away. Our galaxy is in the shape of a giant pin wheel about one hundred thousand light years in diameter. The solar system is located about one third of the way out from the center in the comparatively thin web of the wheel. As we look toward the constellation Sagittarius we are looking toward the center of the galaxy and this region can be seen to be very heavily populated with stellar objects. As we sweep the sky in the direction of the Milky Way we are looking out through the thicker part of our galaxy and the star grouping is noticeably denser in this direction. At right angles to this plane we look through the thin part of the web of our wheel. This is also the direction of the Galactic Pole near Coma Berenices and gives us a clear view of our galaxy. Yet any star we are able to see with our unaided eye is located within our galaxy.

The more diligently we try to study the extent of the universe, the more incomprehensible the numbers, sizes and distances seem to become. Our own galaxy has an estimated 200 billion stars. The individual stars, except for binary systems, are several or many light years apart. Many stars are larger than our Sun, which is a comparatively small star, about 100 times the diameter of the Earth. So far we have mentioned only our own Milky Way galaxy. On a clear night we can see M 31, the so-called Andromeda Nebula. This is the one neighboring galaxy that we can see from the northern hemisphere with the unaided eye. Like ours, it has at least 200 billion stars, two satellite galaxies and many globular clusters. It is located at the totally unimaginable distance of two and one quarter million light years from us. In other words, the light from M 31 we see today, left that object when human life began to emerge on Earth.

We are not sure how big the universe is. Our telescopes cannot see beyond about two billion light years (or about 10 billion light years, depending on how we interpret the quasars). If we assume our universe to be finite and give it a diameter of 10 billion light years, and if we further assume that galaxies are uniformly distributed, we arrive at a figure of nearly two billion galaxies, each, like ours, composed of anywhere from one million to 500 billion stars and separated from its neighboring galaxies by some one to two million light years. Each of these innumerable stars is a sun many times larger than our Earth and many no doubt surrounded by whirling famalies of satellites like the planets in our own solar system. If we divide the sky into areas the size of our Moon, our telescopes can find an average of about a thousand galaxies in such an area. Photographs showing more than ten thousand galaxies on one negative have been made.

The more diligently we try to visualize astronomical magnitudes, the more we find that our iamgination is inadequate. We keep refining our ideas of space as our instruments and intuitive powers improve. But we become lost in mere contemplation of the vastness. Perhaps we can take pride in having made some small strides in picturing our home in space.

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* THE MANY TALENTS OF EDITH. * By Kurt Erland.

Darkness slowly settles on the grounds of Newstead Observatory and gradually one by one the stars emerge out of the evening twilight. Somewhere car doors are slammed and shadowy figures lug heavy equipment into the fields. From time to time the uncertain gleam of a pocket flashlight briefly illuminates the busy hands of a proud telescope owner, struggling to adjust here and there. A slapping sound somewhere signifies the demise of another mosquito - suddenly a brilliant camera flash, eyes blinking, a muffled "darn that Edith!" - and another B.A.A. star night is under way .... Months later, at the annual Christmas party, that same muffled voice roars with laughter as Edith unmercifully displays the fruits of her flashing career.

As everyone knows from experience, one of the many talents of Edith Geiger, our Vice President, is photography. Perhaps not so well-known is the fact that she is also an accomplished musician, composer, lunar observer, painter, teacher, organist, as well as a first rate cook, devoted mother, and adored wife - a woman of unlimited interests ranging from people to paleontology! In high school she was undecided between art and music. She chose the latter as a career but carefully cultivated the former at the same time. At the Eastman School of Music she met Carroll Geiger and they were married one year after her graduation. From then on her interests, as would be expected, closely paralleled his. When he returned to Eastman to work on his master's, she went along to study organ. When he conducted a church choir, she accompanied on the organ. When he became connected with the Board of Education, she became a teacher.

Two years after their oldest son, Loren, was born, the Geigers moved into their new home on Jasper Drive where they have lived ever since. Three more children, Ronald, Bruce, and Karen followed in fairly close succession, all of them inheriting a gift for music and art from their parents. Although Edith had studied Piano, Voice and Trombone at Eastman, her other interests blossomed while she raised her children, including paleontology, philosophy, poetry and photography, and her interest in art, which had never waned, was also continued and expanded. Her work in ceramics brought her prizes in the State Amateur Division, and her teaching talents turned to private students.

At home the Geigers share their talents playing concerts for their own enjoyment (Carroll and Karen play the clarinet, Loren plays the tuba, Bruce with the baritone horn, and both Ronald and Edith play trombone). Never at a loss for something to do (this summer, for example, she tried her hands at raising infant bunnies with better success than Roswell Park Institute), Edith became involved with the Head Start program two years ago and returned to composition, with children songs for these pre-schoolers. She has also set to music superintendent Joseph Manch's "Tribute to Teachers." About 8 years ago Edith also became interested in astronomy, perhaps by way of her concern with philosophy. As with her other talents, she became deeply involved, concentrating on the Moon and on her work with our association. As a skilled recorder of the lunar scene she has few equals, and few in our group or elsewhere can compete with her observing schedule. Her lunar drawings are masterpieces of artistic skill and scientific accuracy. We need not remind anyone of her contribution to our association - suffice it to say that if any work needs to be done, Edith is always ready to do it efficiently and excellently.

When this reporter talked to her husband recently, a quiet pride and admiration shone through as Carroll recounted some of the details of her active life. He singled out her deep concern with people, her enthusiams and her energy which knows no bounds. Hers is a rare kind of personality, always ready to give of herself and of her many talents. Whatever she tackles, she does so with a thoroughness and passion which ensures success. And if you talk to her friends, they speak of her with that same kind of pride and admiration - we are all fortunate to count her as one of our own!

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* THE SUNSPOT CYCLE. * By Ronald C. Clippinger.

The sunspot cycle with an average duration of 11.1 years between maximum periods of activity was first clearly established by the work of Schwabe beginning in 1826. Armed with our present knowledge of this cycle it is interesting to examine older records in the annals of the ancient Chinese astronomers. Not equipped with telescopes, their observations were limited to the larger naked-eye sunspots which could not only be seen when the sky was calm and cloudless, but also foggy and hazy enough to tone down the Sun's brightness to make the spots visible.

There are 95 observations recorded in these annals between February 14, 188 A.D.

and December 10, 1638, some fourteen centuries. The usual description is "fleckle in the sun," but five times the spot is described as "bird-shaped" or "flying bird shaped," twice as "egg shaped," and four times as "like an apple." From our knowledge of sunspots today we can guess what these descriptions represent. The "apple shape" is a round, regular spot; in the "egg-shape" we recognize the great complex spot near the maximum of solar activity, longer than it is broad, drawn out in solar longitude; in the "flying bird" we have the great bipolar stream with its leader spot and trailer spot.

Of the 95 observations listed, 74 were made during the months of November to April, and 21 from May to October. For their purposes better "seeing" conditions occurred in the six winter months. There are gaps, sometimes of several centuries between two consecutive observations, but if we compare the times of the closer groupings, we come up with a surprising mean period of 11.03 years. On the whole, then, we may suppose that something very near our present period has held good throughout the whole of our era. What of the long gaps in these records? Do they simply indicate periods of observational inactivity or unfavorable observing conditions or could the Sun itself have been responsible? With the invention of the telescope early in the 17th century, more systematic solar observations were begun by European astronomers. Although the detection of sunspots quickly allowed the fact of the Sun's rotation period to be established, it was not until the work of Schwabe, as mentioned above, that the sunspot cycle was established by modern astronomy. Why did it take European astronomers equipped with telescopes more than 200 years to discover the sunspot cycle? If we examine their records for the first eleven decades of telescopic observations, we note the following:

1610 Sun fairly active	1634 second observed minimum
1619 first observed minimum	1639 second observed maximum
1625 first observed maximum	1645 third observed minimum

There was a very poor "maximum" in 1650 consisting of only a few spots. Then no clearly defined maxima or minima were to be observed with only a few spots seen at very infrequent intervals. No spots were seen at all between 1661 and 1671 and then again only infrequently until 1715 when they began to return at a rapidly increasing rate, reaching a decided maximum in 1718. After 1718 they resumed their "normal" ebb and flow. Noting the above records, we see that the Sun was a long time recovering from its minimum of 1645. Seventy years elapsed with only a few infrequent spots being observed, and these all required a telescope, none were large enough to be seen with the naked eye. This then explains the long gaps in the Chinese records following 1638, and it should also make evident why the 17th century European astronomers cannot be blamed for their failure to discover the relatively easily observed sunspot cycle. The simple reason appears to be that the "normal" sunspot cycle just was not working at that time in what we have come to consider its "normal" manner. Another odd fact is that during this long dearth of sunspots, all those occasionally seen with one exception (April 1705), were located in the southern hemisphere of the Sun. It was only when spots began to reappear in the northern hemisphere in 1715 that this scarcity of spots ceased.

This period of irregular activity undoubtedly discouraged astronomers from trying to establish any kind of regular pattern and perhaps even led to the opposite view, that irregularity was the usual state of affairs. It also probably discouraged solar observations by astronomers who, under the influence of Newton, were interested in observing phenomena which could be reduced to some mathematical formula. It can be seen then why the Sun had to "prove" itself by more than a century of "regular" activity following 1718 before astronomers were willing to recognize what we know today as the normal sunspot cycle. * For readers interested in a complete listing of the ancient solar observations I refer you to the article by S. Hirayama of the Tokyo Observatory, in vol. 12 of the Observatory. rcc.

NOTE BY THE EDITOR: As Ron indicates, one of the reasons for not discovering the sunspot cycle earlier lay in the fact that astronomers had their interests elsewhere. During most of the 18th and early 19th century astronomers were mainly concerned with celestial mechanics and astrometry. Indeed they often considered it beneath their dignity to study the physical nature of the Sun, Moon and Planets. The great Bessel himself once remarked that studying the surface of the Moon, though a "pleasant" occupation for some, could certainly lead to nothing of significance. (Today, of course, we are spending millions just doing that). It is aslo characteristic that Schwabe's announcement of his discovery of a periodicity in sunspot numbers (1843) received attention only after it had been publicized by Humboldt in his "Kosmos" eight years later. As a matter of fact, Schwabe himself began observing sunspots at first only because he was searching for an intramercurial planet, much like Messier plotted nebulae only because he considered them nuisance objects in his search for comets!! eeb.

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* OBJECTIVES BY PAULY.* By Ernst E. Both.

In the course of my studies in the history of lunar and planetary observations I occasionally came across references to astronomical objectives made by "Pauly." For example, Philipp Fauth's first larger instrument was a 6.5 inch, f/16.5 refractor with a mounting by G. Meissner of Berlin and an achromatic objective by Pauly. Fauth used this instrument from 1890 until 1896, when he mounted a 7 inch, f/17 apochromate by Pauly alongside the 6.5 inch, probably for testing purposes, using the two instruments side by side until 1903. Who was Pauly? The answer to this question took me to some obscure German astronomical journals long since defunct. Most standard works on telescopes carefully neglect to mention this man, and yet, as it turned out, he seems to have been an important link in the development of telescopic objectives and in the history of Carl Zeiss of Jena.

Max Pauly was born on November 15, 1849, the oldest of three children, in the German town of Halle on the river Saale. His father was a restless sort, giving up the security of a government post for wild speculations in mining. The uncertain financial situation of the Pauly family provided Max with a somewhat unhappy childhood. Although a brilliant student, young Max had to drop out of school to help with the family support. The only bright points in his early life seem to have been his artistic mother and his understanding sister Lisbeth. He worked variously as a locksmith and machinist, particularly around 1868 when his mother became paralyzed and Max acted as the sole support of the family. In the early 1870's his father finally found a secure position and Max was able to return to school. He went to the university of Göttingen where he studied chemistry, receiving his Ph.D. in 1876 (he almost missed his examination chasing after a rare butterfly!). Two years later he was appointed director of a sugar factory near Mühlberg on the river Elbe. This position he held until 1897, instituting numerous improvements in the manufacturing of sugar and in the machinery used in sugar production.

Max Pauly had always been mechanically inclined - at the age of 9 he is said to have designed and built an unusual sundial which not only corrected for the equation of time but which also indicated the date. He invented a pressure cooker in 1889 and was a pioneer in microphotography. His other interests included geology, botany, butterflies, horticulture and bee-keeping. Whatever he undertook he became an expert in that field. Astronomy had held his fancy ever since childhood, and in the early 1880's he began his first experiments in lens grinding. Never satisfied with his results, he studied the entire field with a passionate thoroughness both from the practical as well as the theoretical side. In 1885 he saw a reflector at an exhibition in Görlitz with an exceptionally fine mirror made by a "von Schlicht" (mounting by G. Meissner) of Potsdam. Von Schlicht had apparently made various optics for the Potsdam Observatory and Pauly went to him for advice on various practical problems. From then on Pauly took up lens grinding scientifically and seriously. * (To be concluded).

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