COMET HUNTING AS A PROFESSION

By Mary Proctor

WHILE perched on the roof of the Princeton Observatory, sweeping the heavens with his five and three-quarter-inch telescope, on the night of December 6, Zaccheus Daniel, a graduate student of Princeton University, discovered a comet. This is the third comet to his credit, the other two being the comets of June, 1907, and June, 1909. As is usual in such cases, the celestial visitor was named according to the year of its discovery and after the one who first detected its presence in the sky. The fact that Mr. Daniel has claim to three comets shows that he is fairly entitled to membership in the unique guild of comet hunters, who make it their special work to search for these celestial visitors from the sky which have a way of suddenly blazing out when least expected.

"Comet hunting is a pursuit which may well be taken up by amateurs with plenty of spare time on their hands," says Professor G. F. Chambers, in his timely and interesting book, "The Story of Comets," "because, if the truth must be told, it involves an immense waste of time, with results that present themselves only at long intervals."

Otherwise, comet hunting may be said to be an easy matter, for all that is required is a telescope of moderate size (from four to six inches' aperture), a clear horizon in the neighborhood of the sun either in the west after sunset or in the east before sunrise, and plenty of patient, plodding perseverance on the part of the observer. An eyepiece of low power and with a large field should always be used, while sometimes an enthusiastic seeker after comets will provide himself with a telescope specially designed for the work and known as a "comet seeker." On the main roof of the Yerkes Observatory, between the two small domes, is a comet seeker of six inches' aperture, made by Professor Brashear of the Allegheny Observatory, and many others are in use at various observatories.

Two French Hunters

NO definite effort was made with regard to a systematic search for comets until the close of the eighteenth century, when two French astronomers devoted their time and energy to a careful hunt for these visitors from the star depths. These Frenchmen, named Messier and Pons, maintained a friendly rivalry in the pursuit, though disturbed occasionally by others who ventured to intrude, as it were, in the cometary realms.

The following story is told of Messier by La Harpe, showing the keen zest with which the former sought comets, and his disappointment when another captured the prize so nearly in his grasp. Some years before, according to the story, Messier lost his wife, and while caring for her during the last few weeks of her illness he was hindered from seeing a comet for which he was on the watch. Meanwhile, Montaigne of Limoges found it, and Messier was overcome with chagrin when he heard the news.

After the death of his wife some one sympathized with him regarding the loss he had sustained. Still thinking of his comet, he replied, "Alas! I have found twelve comets, and Montaigne has robbed me of my thirteenth." Thereupon tears filled his eyes. Then, remembering that it was for his wife he ought to weep, he remarked, "Ah, poor woman!" but it was really for the comet that he was weeping.

In 1835 the King of Denmark, Frederick VI., offered a prize of a gold medal to all discoverers of telescopic comets, and several such medals were awarded. The grant of this medal was continued after the King's death in 1839, by his successor, Christian VIII.; but it was discontinued after the death of the latter in 1848. The Vienna Academy of Sciences formerly gave a gold medal to the discoverer of every new comet; but this lasted only until 1880.

A House Built by Comets

THEN Professor H. H. Warner offered a prize of two hundred dollars for every unexpected comet found by observers in the United States and Canada. This was an incentive for renewed zeal in this direction, and gave rise to the following story related by Professor E. E. Barnard of the Yerkes Observatory, Williams Bay, Wisconsin:

"Times were hard in the last of the '70's and the first of the '80's and money was scarce. It had taken all that I could save to buy my small telescope. I had been searching for comets for upward of a year with no success, when a prize of two hundred dollars for the discovery of each new comet was offered by the founder of the Warner Observatory, through the agency of its director, Dr. Lewis Swift.

"Soon after this it happened that I found a new comet, and was awarded the prize. Then came the question as to what should be done with the money. After due deliberation it was decided that we would try to get a home of our own with it. I had always longed for such a home, where one could plant trees and watch them grow up and feel we owned them. So we bought a lot with part of the money. This small lot was on beautiful rising ground, which I had selected partly because it gave me a clear view of the horizon with my telescope. After some saving and some borrowing, and mainly a mortgage on the lot, we built a little frame cottage, where I went to live with my mother and wife. Those were happy days, though the struggle for maintenance was a hard one. It meant working from early till late for the means of a bare existence and the hope of paying off the mortgage, and sitting up all the rest of the twenty-four hours hunting for comets.

"We could look forward only with dread to the meeting of the notes that must come due. However, when the first one came, a faint comet was discovered wandering along the outskirts of creation, and the prize money went to meet the payments. And this continued after we had gone to other scenes. The faithful comet, like the goose that laid the golden eggs, conveniently timed its appearance to coincide with the advent of those dreadful notes. And thus it finally came about that the house was built entirely of comets.

"This fact goes to prove further the great error of those scientific men who figure out that a comet is but a flimsy affair, after all, infinitely more rare than the 'breath of the morning'; for here was a strong, compact house, albeit a small one, built entirely out of them. True, it took several good sized comets to do it; but it was accomplished nevertheless."

Many Rival Hunters

DURING the last thirty years four astronomers have outdistanced all their rivals in the world in their discovery of comets, even to the exclusion of the Germans, who have done a great deal in connection with this work. Between 1877 and 1908 no fewer than twenty discoveries stand to the credit of Professor Brooks, nineteen to Professor Barnard, thirteen to Professor Perrine, and eleven to Dr. Swift. These figures compare very favorably with the thirteen comets discovered by Messier between 1760 and 1798, and the twenty-seven discovered by Pons between 1803 and 1827. The most successful European hunter of comets seems to have been Giacobini of Nice, who has twelve to his credit.

The Warner prize has been discontinued for sometime; but the idea was revived again by a wealthy American, J. A. Donohoe, in 1890, and a bronze medal is now regularly presented to the discoverer of any unexpected comet, on the report of a committee of the Astronomical Society of the Pacific. In 1900 a German named A. F. Lindemann, living at Sidmouth, placed at the disposal of the German Astronomische Gesellschaft a fund to encourage the computations necessary for determining the path of a comet. Twenty-five dollars is paid for each path accurately determined.

An interesting example of the way in which comets can be found to order, if one may so express it, was given some years ago by Professor Boss of the observatory at Albany. The board of visitors at the observatory doubted the value of some work in course of preparation by the director, which was desk work, and not done with a telescope. They inquired if it would not add to the reputation of the observatory if some discovery such as that of a comet could be made. They were promptly informed that nothing was easier if they would award a sum of money for the purpose, as a salary toward defraying the expenses for a person of average intelligence while making the necessary search.

The challenge was accepted on the spot, the money subscribed, and a searcher selected for the work. Within the allotted time a fine comet was found; but undoubtedly Professor Boss had taken a risk in undertaking to catch a comet within a definite time. The probabilities were as uncertain as in the case of a man who undertakes to catch a fish in half an hour.

Zaccheus Daniel's Work

ZACCHEUS DANIEL went to Princeton from Bucknell University in time to be graduated from old Nassau in 1908. At Bucknell he had taken up astronomy as a fad, and later as a real vocation in life. To this end he made strenuous efforts to win the Thaw fellowship in astronomy, the annual income of a gift of ten thousand dollars by Mrs. William Thaw of Pittsburgh, and was successful. Since then he has devoted all his energies to this pursuit, although it has been his favorite study ever since he was a boy. In fact, long before he came to the university he possessed a four-inch telescope mounted on a tripod. Every fine evening, winter and summer, he scans the skies with a five and three-quarter-inch telescope, and once more his efforts met with success, in the capture of the comet of last month.

He estimated that the comet was probably about three times as large as the earth, or some twenty-five thousand miles in diameter, and was traveling through space at a distance of fifty-six million miles from the earth. It was apparently composed of such flimsy material as to be literally transparent, as Daniel saw a bright star through the comet, somewhat as one might perceive the gleam of a diamond through the filmy gauze of a veil. The comet was seen the day after its nearest approach to the sun, and was therefore starting on its return journey to the region whence it emerged before it came within our ken.

DO YOU KNOW?

Perhaps You Do
Perhaps You Don't

CAN an ice yacht travel more rapidly than the wind that drives it?

Even the careful thinker will probably reply at once to this question with a decided negative and classify it with such evidently futile queries as, "Can the cart go faster than the hand that pushes it?" or "Will the carriage run away from the horse that draws it?"

But we must be careful here; for analogies are frequently as dangerous as they are seductive, and this happens to be a particularly unfortunate one. Let us consider the question for a moment from the viewpoint of the facts, and concern ourselves with the explanation later. Ask the weather man, and he will tell you that it is an ill wind that blows more than forty miles an hour,—that is, ill for the one who happens to be out in a boat in it,—and the man who would venture out in a greater wind than this with any sort of craft carrying sail would be foolhardy indeed.

Now think over your own experiences in iceboating. Remember your sensations on the first fast trip when the boat got well under way, sailing nearly across and a little with the wind, the windward runner lifting a couple of feet in the air,—for hours at a time, as it seemed to you in those anxious moments,—with every stiff puff? You had probably tobogganed before this, and had perhaps ridden on the Empire State Express; but I will wager that as you lay there with your face a scant foot from that blurring sheet of ice you felt you were really going for the first time in your life.

Nor is this comparison of the speed of an iceboat with that of an express train an exaggeration. Speeds of fifty and sixty miles an hour are not uncommon, and these in moderate winds whose velocities are by no means so great as this. Indeed, we read of races on the Hudson between iceboats and the fastest express trains, when the speeds are reported as high as seventy or even eighty miles an hour. It will probably be admitted without question that no craft carrying sail could keep upright for an instant if the wind itself had such hurricane dimensions.

We must confess then, that, however paradoxical it may seem, the ice yacht can and does at times go faster than the wind. In seeking to explain this puzzle the first thing to be noted is that when making the greatest speeds the boat is not sailing directly before, or in the direction of the wind, but rather across it, perhaps going a little with it also. The sail too is hauled in until it makes only a small angle with the median line of the boat or direction of motion.

Now, dropping for the time the idea of sail and wind, consider what happens when a force —*e.g.*, the pressure of the foot—is applied to a smooth, slippery, wedge shaped stone or piece of wood. The chances are that it will fly out with considerable velocity along the sidewalk; that is, in a direction at right angles to the applied force. A somewhat similar case is that of the toboggan on a moderate slope. The pull of gravity downward results in a force that causes the motion nearlp at right angles to this.

While presenting a slightly more complicated case than either of these, the sail on the iceboat acts in almost the same way in transforming the force of a side wind into a force in the direction of motion of the boat. Then, if the boat encounters no friction, it will evidently speed up until the wind exerts no further pressure.

To see when this will happen, take a pencil and sketch roughly the plan of a boat, and to give the ideas concreteness suppose the boom is sixteen feet long and that the end is five feet out from the center line of the boat. The base of the triangle of which these two sides are the hypotenuse and altitude respectively lies along the middle line of the boat; that is, in the direction of motion, and by the law of squares is approximately fifteen feet long.

Now, as the boat advances the length of this side, or fifteen feet, the wind can blow sidewise only the amount of sidewise displacement of the sail from mast to end of boom; that is, five feet. This means that the boat would have to be going sixty miles an hour for the sail to feel no pressure from a side wind blowing only twenty. Since, however, there is always friction and air resistance to be considered, the ideal case will never be realized, and the boat will never go quite so fast as would be computed from the velocity of the wind and the setting of the sail.