about the same time, and are entitled to about equal weight. Using for Titan a mass of $\frac{1}{4700}$, and a diameter of 0″.70, as corrected for irradiation, the resulting density is 2.03, which seems admissible. On the other hand a diameter of 0″.52, such as is indicated by the measures of Barnard and those made by the writer during the opposition of 1900, would lead to a density of 5.6, greater than that of the Earth, and therefore improbable. Moreover, careful measures during the present opposition indicate decidedly that the diameter is probably about 0″.90, somewhat greater than that obtained last year. The mass of Japetus is unknown, and the diameter very small (probably about 0″.3), so that no determination of its density can be made. The result of this inquiry, so far as it may be considered decisive, indicates that the average density (2.36) of the satellites is about the same as that of the matter which composes the crust of the Earth.

WASHINGTON, D. C.,
1901, Aug. 16.

UPS AND DOWNS, AND HERE AND THERE OF AN ASTRONOMER.

LEWIS SWIFT, F. R. A. S.

FOR POPULAR ASTRONOMY.

My astronomical work in California being ended, I find myself again in Marathon, near where I first commenced the study of astronomy without a teacher, and on a very small scale, armed only with a determination to succeed. My arrival brings forcibly to mind the early resolve to succeed in spite of obstacles which I clearly saw would certainly arise, and must be surmounted.

It has occurred to me that perhaps a brief recital of my failures and successes, and the disadvantages under which I for many years labored, may not be wholly devoid of interest and profit to the astronomical student, as an example of what perseverance can do.

Some 45 years ago, I bought of Mr. Spencer, the celebrated microscope maker, a 3-inch achromatic object glass, damaged by a streak in one of the lenses, for five dollars. I made a tube for it, and an eyepiece, and commenced the examination of the heavens, this being my first view of celestial objects through a telescope. The pleasure however was of short duration, as a careless servant girl broke the crown lens. I then ordered of Henry Fitz, of New

York, a 4½-inch comet seeker. For that I built a small Observatory with a conical revolving dome covered with canvas, five miles from this village. In a year or two I moved to Marathon, but finding no good place to use it, I cut a hole through the gable of my barn to crawl through, and built a platform on which to observe. My first stroke of luck was the discovery of the famous comet of 1862 III, having a period of 122 or 123 years and whose elements are almost identical with the August 10th star shower.

My astronomical library consisted only of Burritt's atlas and book, by the aid of which I began to learn the names of the brighter stars and boundaries of the constellations. In 1872 I moved to Rochester, my observing place being in a dark alley, lying in the dirt in the summer, and snow in winter.

My first mishap occurred one evening when a lady and gentleman came to look through the telescope, and to show them the object I desired I was obliged to move it a short distance; in doing so I stumbled over a little mound of dirt some children had made and with the telescope fell to the ground. The glass was not injured, but the object end of the tube was made very slightly elliptical. Curiously enough when the weather was mild, I had no trouble to screw the object glass cell into it, but never could when the weather was of zero temperature. For the result one cold night see further on.

One dark night one of the proprietors of the cider mill happened to go into his back yard, a thing he seldom did, and leaning against the fence saw what he said was either a black bear, or a drunkard, or the devil wallowing in the dirt. If it was the latter gentleman he desired to make his acquaintance. Softly approaching the strange object it proved to be a man looking at the sky with a telescope! Finding I was nightly engaged in comet seeking, said the flat roof of the cider mill would be a good place for me, and that I could use it if I desired. The next day I transported my telescope to it. Its flat pebbled roof was large, thus cutting off the near by street lights. It was a half mile from my residence and to get to the top it was necessary to climb three ladders and what was worse, to walk some 100 feet on a slanting roof, which in the early morning hours was often covered with frost, necessitating walking on hands and knees.

There during five years, being a hardware merchant by day and a comet seeker by night, I discovered six comets, besides a bitter experience. On a very cold night, as before said, I was unable to screw the objective into the tube, so was obliged to let the screw

threads cross. Shaking it strongly it was pronounced safe. About midnight, frost condensing on the glass, I attached the dew tube, which on removing at daylight somehow detached the objective, and falling on the pebbled roof broke the flint lens into a thousand fragments, but did no damage to the crown, which I sent to the Clarks to repair. Stumbling over the pile of dirt in the alley cost me one hundred dollars.

For fear of fire, I always carried home in a basket the glass and the eye pieces, being often stopped by policemen taking me to be a thief!

Dr. Ralph Copeland, Astronomer Royal of Scotland, on his return from his transit of Venus expedition, visited me, and after the first salutation was over desired me to take him to the cider mill. Arriving, the proprietor who saw me in the alley, said: "No wonder he can find comets in such a spiritual place!" About these days I was introduced to a Mr. H. H. Warner who handed me a twenty dollar bill and said, "if you want any more come over to the office and get it." It appeared a strange reception from a perfect stranger. Afterwards meeting him he said: "If the people of Rochester will buy you a 16-inch telescope I will build a nice Observatory and dwelling attached." Drawing up a subscription paper, I made a desperate effort to raise the sum needed. Enough was soon raised to pay for the telescope, spectroscope and sidereal clock, amounting to twelve thousand five hundred dollars.

True to his verbal promise he began its construction of white sandstone brought forty miles. The attached residence was finished off in hard rare woods, which, including the site, must have cost him $40,000. When about half completed he handed me his check for $500, saying, "put this under the carpet, it will come handy when you get in the Observatory." I also received from him $400 as prizes for the discovery of comets and a beautiful gold watch.

While director of the Warner Observatory, I discovered several comets and nine hundred nebulæ. Afterwards the generous man failed and I was obliged to abandon the beautiful Observatory, which cast a gloom over the city as well as me. In 1894 Professor T. S. C. Lowe, of Pasadena, Cal., was engaged in building an electric railway up the San Gabriel mountains, and desired the astronomical equipment transported to an Observatory. He promised to build 3700 feet above the Pacific Ocean which was plainly visible. He desired it as an additional attraction. The Observatory was completed, the instruments mounted, and while

its director, I discovered two more comets and 340 more nebulæ. My son Edward also discovered a comet with the 16-inch, the only one ever found with it. While there my wife died and I brought her remains here and buried her beside a former wife. Shortly after my return two men broke into my sleeping room, and seeing me said, "the hotel is on fire." Seizing my clothes and medals rushed to a place of safety but lost many articles and papers of value. Previous to this I saw with my naked eye a comet within half a degree of the Sun's upper limb at sunset. Seizing an opera-glass I was astonished to see another and fainter, about a half degree north of it and some distance from the Sun. Both were afterwards seen by the manager and several employees through three different opera-glasses. The sky was red like our eastern Indian summer, the Sun being seen without discomfort. They, especially the brighter, must have been very bright to have been seen through such a sky by daylight. I failed to find them again with the comet-seeker.

To my regret Professor Lowe also failed, which again brought my work to an end. Then my good eye failed, which was a great disappointment. I had done all my telescopic work with it. This compelled me to dispose of my entire equipment, except the comet seeker, which my children forbade me to sell. The instruments are still with Lowe Observatory under the directorship of Professor E. L. Larkin, who is making valuable discoveries, particularly with the spectroscope, the mountain atmosphere being especially adapted for it.

Those who have followed me through this checkered digest will see that what I have accomplished under discouraging difficulties, has been the offspring of perseverance, the details of which I have writen for the amateur to follow where unfathomable mysteries in the heavens still await him to solve, only hoping that he can say as do I, that sometimes

"Though bitter has been the bud,
Yet sweet has been the flower."

THE LIGHT CURVE OF THE NEW STAR IN PERSEUS.

H. C. WILSON.

[CONTINUED FROM PAGE 454].

In the collection of the observations we have attempted to gather and arrange in chronological order all of the observations which will be of value in determining the light curve and to give such of the details of the comparisons as will enable anyone to