STARS IN THEIR EYES

Twelve years ago, retired sailor Gilbert Clark started giving children a healthy dose of virtual reality by letting them look at the Milky Way (above) and beyond through mammoth, multimillion-dollar telescopes from their computers. Since being selected as a Rolex Laureate in 1996, his Telescopes in Education (TIE) programme has soared skywards, becoming an immensely valuable part of the curriculum at hundreds of schools in many countries.

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Grey-bearded Gilbert Clark seems out of place in today's scientific community of ambitious, young astronomers, most of them armed with doctorates. He spent 20 years in the U.S. Navy before getting his first degree, a Bachelor of Arts, hardly the sort of academic record you might expect from one of America's best-known astronomers. But Clark has thrived in several careers by taking unorthodox paths.

Today, he heads Telescopes in Education (TIE), a virtual observatory that links schools to some of the world's most powerful optical telescopes. Using relatively simple computers at their schools, students can operate research-grade instruments in California, Australia and Chile – and, soon, Arizona, in the United States. By putting these expensive devices online, TIE has rejuvenated an ancient science, bringing what was once the prerogative of a handful of astronomers to school children in the remote hills of Japan, Poland and elsewhere.

In March 2005, TIE began moving its operations from the crowded Mount Wilson Observatory in California to the Arizona Sky Village (ASV), several hundred kilometres to the east. While

Clark explains the shift was necessary for budgetary reasons, he has found a "silver lining" in the pristine skies over Arizona. "This is the darkest site that I have seen in the United States," he says. In other words, a fine place to look out at the universe.

Among their many notable accomplishments, TIE users have helped revise the ephemeris (orbital location) of Pluto. With the new facilities, Clark expects even more astounding results.

Budget cuts in recent years at such major sponsors as NASA have reduced Clark's funding and at one point it looked as though TIE would have to downsize drastically. But, as with his first TIE telescopes, he has masterfully improvised. Besides putting about US$150,000 of his own money into the programme, he has been working for free at TIE, as have many of his colleagues – only his primary telescope technician and operations manager draw salaries, paid in part by grants from Raytheon, a defence technology firm, and from the Ahmanson Foundation.

Several other earthlings then intervened to keep the programme growing. First, a volunteer telescope operator, Roger Clark (no relation), donated $25,000, and other stargazers began offering help. Next, *Sky and Telescope* magazine reported TIE's plight in its pages.

"Soon after, I was contacted by Gene Turner and Randy Norric of Arizona Sky Village (ASV) in Portal, Arizona," Gilbert Clark recalls. "They are developing an observatory on a 1,970-metre peak in the Arizona desert, and offered free use of their facilities."

The Arizona site has skies far more "transparent than any previous location" and Clark has offered his accumulated know-how for future telescope installations there. To make sure TIE gets off to a bright start in this "Old West" state, he has established an office at the future observatory complex, where he will move most operations from his headquarters in Pasadena, California. Around Portal, Clark hopes to duplicate the "neighbourhood success" enjoyed in California where 10,000 people attend an annual open house and the local school board invited him to bring TIE to schools under its supervision. Clark describes the Portal site as "simply phenomenal" and the people there as "true professionals".

The first of what he expects to be many giant strides involves bringing another eight huge telescopes online and starting a truly Global TIE Observatory (GTO), while creating a comprehensive database to make images from the world's best observatories available to students.

When asked why, he answers simply "because somebody has to do it". In addition, Clark refuses to charge schools and students for the service. "For those in developing countries," he explains, "the cost would be tantamount to the salaries of one or two teachers." Clark sees other potential problems in charging for telescope time: "Some schools could pay, but this would be unfair to others, and

Architectural plans (left) show the installation site for a new telescope in Arizona Sky Village where an observatory is being developed by Gilbert Clark (opposite), photographed at the Norric Peak site.

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who's to decide what and which?"

His adamant stand not to charge for TIE's services has cost him some long-term support from those who think the programme should be charging users and thereby becoming financially self-sufficient. This does not bother Clark at all. "There's not enough benevolence in the world as it is," he says.

This philosophy has made a huge difference. An astronomer who was exposed to TIE in a Los Angeles high school before matriculating to America's prestigious George Washington University describes the programme as "a tremendous educational asset for any science curriculum". He adds that TIE makes the observing location irrelevant, and "allowed the nascent scientist in me to blossom". His experience with TIE has led him to form a team to search for planets outside our own solar system.

Clark's growing stature in the stargazing world comes not from discovering new planets or tracing the trajectories of comets. Rather, his contribution stems from the practical application of user-friendly technology to an immensely complex field. In the process, he has helped renew interest in other such difficult fields as physics and calculus.

TIE began as an experiment at a small California high school. The resounding success of this pilot effort soon convinced such major players as NASA and the Jet Propulsion Laboratory to become involved. The genius of Clark's concept was the realisation that many large,

"research-grade" telescopes were used only sporadically by scientists or were not used at all, in some cases due to the slow creep of light pollution around them and in others because of the development of more modern technology, such as radio-imaging and space-based systems like the Hubble. Even if they were no longer capable of cutting-edge science, these older instruments offered real research opportunities in astronomy, especially for educational purposes.

Clark then applied his expertise as an engineer to combine the telescopes' optical potential with the latest IT advances so that anyone with a phone line and a computer could explore outer space in real time, using a range of powerful telescopes.

For centuries, astronomy below university level was taught only through textbooks. "By graduation, most students had never even looked through the eyepiece of a telescope," Clark reflects. The problem was even more severe in inner cities, remote rural areas and other relatively poor communities where educational emphasis on topics such as astronomy, as well as access to observing facilities, was limited or non-existent. TIE is helping change all that and, as computers and computer literacy have spread, so has TIE, which is now being used by 4,000 students a year. In fact, studies by national and regional organisations in the U.S. clearly show a direct correlation between TIE and the number of high-school graduates accepted into science and engineering programmes at top American universities.

In Italy high-school students supervised by Dr Gianluca Masi, at the University of Rome, use TIE to study near-Earth objects. Masi calls the programme "a true winner", saying it helps students accomplish ambitious goals. He explains that TIE makes school more rewarding by allowing even young students to do real research.

Clark is constantly thinking about new ways to make TIE more effective. He describes the history of the Native Americans around his new site in Arizona as "mind-boggling". This has motivated him to start developing an "archeo-astronomy" curriculum that would add an entirely new dimension to TIE by letting students discover how ancient civilisations looked at the stars.

"There's still much about our own tiny planet we don't understand," he philosophises. "And the more we look outward, the better equipped we are to look at ourselves."

At last count, Clark had installed CCDs (charge coupled device; similar to a television camera) and related hardware on telescopes on three continents. To optimise performance, he has also developed several succeeding generations of software to link remote viewers and give them bigger, brighter pictures. In the process, he has helped educate tens of thousands of fledgling scientists in 25 countries.

Two years ago, TIE teamed up with the Carnegie Observatories to bring on-line a telescope at the Las Campanas Observatory in Chile. Already, students using it have observed what appeared to be an asteroid turn into a comet, and were the first to report this discovery. A similar partnership was formed with the Queensland University of Technology (QUT) in Brisbane, Australia.

Clark's contribution has been recognised by the International Astronomical Union, which renamed the newly discovered 74625 asteroid "Tieproject". Clark himself has named one of the main telescopes used by TIE "The Heiniger", after the late André Heiniger, the Rolex CEO who established the Rolex Awards for Enterprise.

Remembering the "genuine warmth, hospitality and interest of the entire Rolex family" that he experienced when he visited Geneva to accept his Rolex Award, Clark hopes to build a metre-class telescope at the new site and move the Heiniger name to that instrument.

Clark has no intention of slowing down even though he is approaching the age of 60, when most people are planning retirement. TIE actually intends to increase the number of telescopes available to students. New schools can still participate in TIE, but the range of its services will remain limited by budgetary restraints until more money comes in. Despite help from supporters like Raytheon and Telstra, Australia's telecom giant, which is providing free satellite communications, TIE still needs fresh support.

One teacher who uses TIE at her school in New England in the U.S. says that all good astronomers are slightly mad – although in a quixotic way. "TIE," she declares, "has opened the skies for my kids, but, far more importantly, it has opened their minds." The cosmos, some say, was created out of nothing. Gilbert Clark is creating a better way to understand it out of ether in the high deserts of Arizona. "We're all mad in our own way," he suggests. "Some of us are just more methodical about it."

Bob Guthrie

Schools and others interested in TIE can contact Gilbert Clark at **mcragg@earthlink.net** or visit TIE's website: **telescopesineducation.com**

Gilbert Clark and colleagues (left) observe clear skies from Norric Peak, where their telescopes will become part of the new observatory's advanced technology. School children (below) in San Simòn, a town near Arizona Sky Village, learn about astronomy as part of Clark's Telescopes in Education (TIE) programme.