GEOSET at FSU: A Groundbreaking Global Educational Internet Initiative

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I had never contemplated leaving the University of Sussex in the UK and had not even considered any of numerous invitations I had had over the years to move to the US or any other UK or non-UK position. But as I suddenly reached the age of 64 and was staring retirement in the face I suddenly realised that I had a lot of unfinished business. There were one or two fascinating (at least to me) scientific problems that I still wanted to study and in particular I wanted to explore the way the Internet could be used to improve the level of science education on a global scale. At about this time I was accessing my emails in the office of a professor at Stanford where I was visiting when an email arrived from Alan Marshall, a Florida State professor, saying "Crazy idea, how about coming to Florida State University." I had known Alan ever since the Summer of 74 when I had been on a 3-month sabbatical at the University of British Columbia and had shared a room with him. Actually, if the truth be known, the main proprietor of the room was a large electric eel that stared at us through the glass walls of its tank. The expression on the eel's face indicated that it would really have liked me to put my hand in the tank. Alan at the time was working on acetylcholine, a neurotransmitter (an important compound involved in transmitting signals along nerve cells to the brain) and these fish, which are basically 400 volt batteries with a head, contained a lot of this molecule. A bunch of them together apparently can kill a large animal such as a cow.

All decision-making discussions are really hypothetical exercises until real decision-making time actually arrives. The email from FSU came at just the moment when I realized that I had to make such a decision and my wife and I decided we should at the very least pay a visit to FSU. Don Foss, then Dean of Arts and Sciences met me at the airport and I met many members of the Chemistry Department. Everyone I met such as Sandy d'Alembert, then President of FSU, and Naresh Dalal who was the Chair of the Chemistry Department at the time as well as many members of the Chemistry Department and of course Alan made it clear that I would be extremely welcome were I to

come to FSU. In the end the deciding factors were threefold; firstly the possibility of working with Alan using the state-of-the-art capability of the mass spectrometers he had developed at the National High Magnetic Field Laboratory, secondly the possibility of working on some fascinating new materials with Naresh Dalal and a new cohort of young FSU research students and thirdly – and in particular – an enthusiastic response to my aim to develop further my global educational outreach initiative at FSU using the Internet.

I already had about a dozen years' experience developing my Vega Science Trust initiative. Vega was a foundation focused on the production of programmes which had been made originally for BBC TV. I had created it as a platform for major scientists and science educators to communicate directly with the public and students on a wide spectrum of issues from those in which they were expert in and fascinated by, to those that were important to society in general and concerned them. Vega has been a great success, pioneering Science programmes of all kinds: Lectures, interviews, careers programmes, children's science workshops, masterclasses, round table discussions, and since it started, it has produced over 300 programmes of all kinds and some 70 have been shown on BBC-TV. In our round table discussions we pioneered a new concept in debate on TV – that participants should actually know something about the subject! All the programmes we have made are now streaming free from the Vega website at www.vega.org.uk.

When my wife, Margaret, and I finally arrived in Florida and I took up my post at FSU during the years 2004-2005 I was able to settle down very quickly as my new colleagues made every effort to make us feel at home. Starting on a science research career the first time was hard enough but starting a second time is much harder - especially as I had indelible memories of just how difficult it had originally been. Scientific research is of its very nature highly unpredictable and when starting from scratch one generally does not have the backup projects that are needed as many avenues lead to dead ends. However a great bunch of graduate students decided they wanted to work with me (Fig 1) and they all persevered in helping to set up an effective and successful research programme.

Fig 1 From the left Nicola Pugno (visitor from Italy), HK (in Oz hat), Prashant Jain from India, Artrease Spann from Georgia, Darryl Ventura from Chicago, Steve Acquah a postdoc who came out with me from the UK. Paul Dunk from Florida is sitting next to a statue of the supreme physicist Paul Dirac. Dirac's statue is almost as monosyllabic as it appears Paul was in real life (see the biography "The Strangest Man" by Graham Farmelo)

We have managed to initiate successful projects on three fronts: 1) Grad student Prashant Jain together with Naresh Dalal at FSU and Tony Cheetham formerly at UCSB and now at Cambridge (UK) we have created some novel new materials which exhibit useful electrical and magnetic behavior, (Fig 2a and b.) Although not directly applicable yet they open up new horizons in the way these materials might one day be used in the next generation of computer storage devices (Fig 2.)

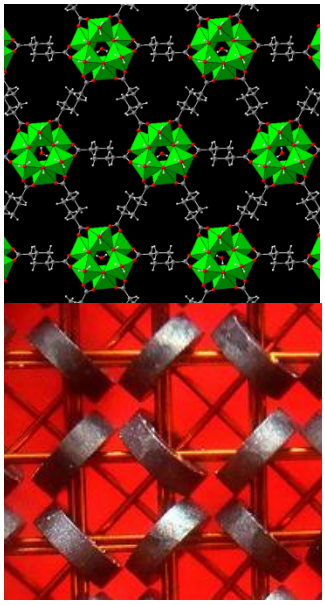

Fig 2 a) Nanoscale array of nickel clusters connected by organic linker molecules. B) Magnetic doughnuts on a wire: The ferrite core memory from an IBM 360 Main Frame Computer (-- circa 1966) on the right serves as the stimulus for a nanoscale molecular analogue on a 100 million times smaller scale. The doughnuts are rings of a magnetizable (ferrite) metal which are alternately magnetized and demagnetized and then can be "read" as either a zero or a one. Each doughnut is one bit, four doughnuts made one byte and two bytes made one word in the good old days before 32 bit systems. Only when current ran through two wires at right angle at a specific junction at the same time was it strong enough to switch on the magnetization
http://www.flickr.com/photos/19779889@N00/sets/72157625488314133/detail/?page=5

With two other grad students Darryl Ventura and Artrease Spann together with my colleague Steve Acquah we are exploring some advanced electrical and tensile strength properties of nanostructured materials. Fig 3 shows a microscope image of one such structure which has been created

and juxtaposed next to a well known structure that is recognizable without a microscope.

Fig 3 Nanoscale polymeric structures have been created spontaneously which show a remarkable parallel with the honeycomb structures created by bees whose constructions are about a million times larger.

With Alan Marshall, who first alerted me to the possibility of coming to Florida, we are studying some intriguing problems associated with the breakthrough made more than 25 years ago which led to the award of the Nobel Prize for Chemistry in 1996. Still numerous fascinating questions surround this original breakthrough which involved the discovery that when carbon vapour is allowed to cool under certain conditions the atoms invariably self-assemble into a structure in which the exactly 60 atoms form a spheroidal hollow cage molecule with the same pattern as a modern soccer ball which has 12 pentagonal patches and 20 hexagonal ones (Fig 4.)

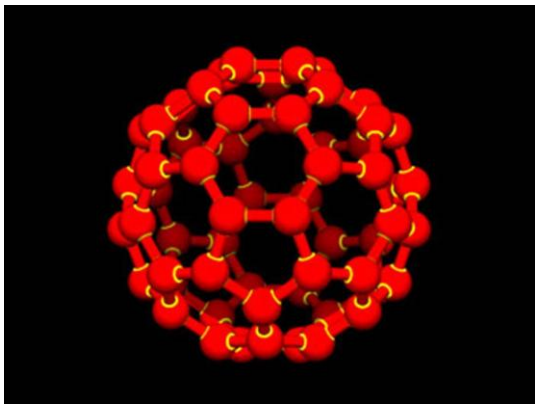

Fig 4 Visualisation of a computer model of the C_{60} Buckminsterfullerene molecule. The molecule was discovered by chance during experiments aimed at understanding the chemistry in red giant carbon stars. The sixty carbon atoms are located at the apices of a truncated icosahedron which has the same pattern as the modern soccer ball with 12 pentagonal patches and 20 hexagonal ones. The molecule is almost exactly one nanometer (a billionth of a meter) in diameter and it has become the iconic supermodel of Nanoscience and Nanotechnology. I named it after Buckminster Fuller because his geodesic dome structures provided an essential clue to concluding what the likely structure might be. It is now often called "the Buckyball," a rather less imposing title but one that kids like, so that is fine. There are other cages, both larger and smaller, and the whole family is now known as Fullerenes.

A key aspect of the original discovery – *i.e.* how the atoms could assemble into such a pleasingly symmetric structure – is still somewhat of a mystery. When we first discovered this phenomenon in 1985 it appeared extraordinary – it was as though one had thrown balls onto a snooker table and they had all spontaneously rolled into the familiar starting triangular pattern

without the aid of the triangular frame. With grad student Paul Dunk and my colleague Alan Marshall we are trying to unravel the mechanism of this almost magical process. We are using the amazing power of the FT-ICR-MS system - or to give it its full (mouthful) name – Fourier Transform Ion Cyclotron Resonance Mass Spectrometer so everyone in the street knows what it is! – developed by Alan at the National High Magnetic Field Laboratory to develop further understanding of the still surprising process that led to the discovery of the Buckyball. We are also studying how atoms become trapped inside the fullerene cages (Fig 5.)

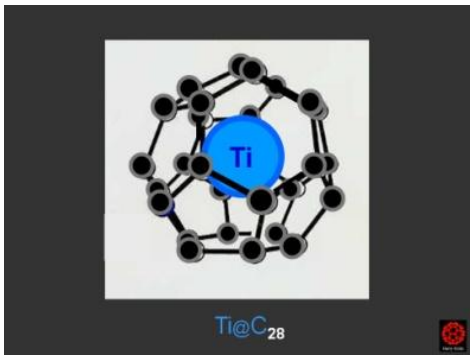

Fig 5 This small 28 atom fullerene cage has trapped an atom inside. At the National High Magnetic Field Laboratory we have been studying the properties of these systems. Such compounds promise interesting possible applications in MRI imaging as well as non-toxic delivery of medically effective agents.

C_{60} is the third form of carbon – diamond and graphite which have been known since time immemorial are the other two. Buckminster Fuller's Geodesic Domes were instrumental in arriving at the correct conclusion as to its structure and it was for this reason that I named the molecule Buckminsterfullerene. Since then it has often been called the Buckyball for short – not quite such an imperious name but as kids love the name and that is great.

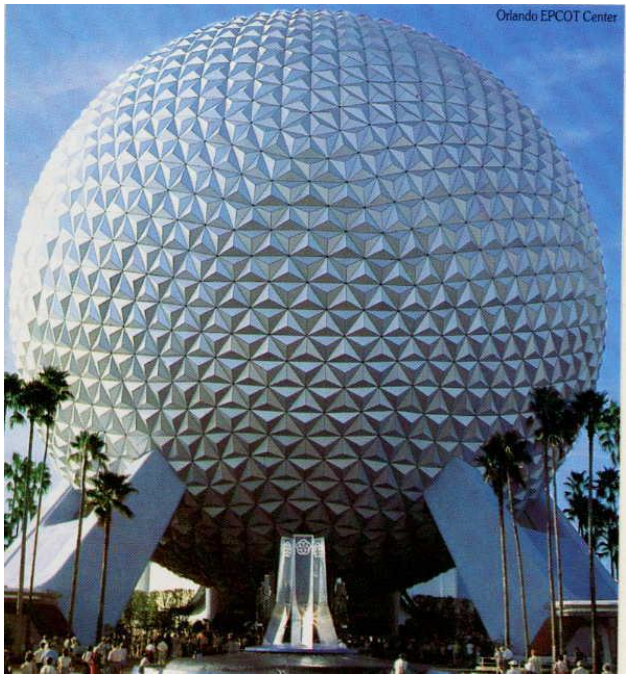

Fig 6 The Epcot Centre Geodesic Dome is a very interesting structure. At first sight it looks like a multitude of trigonal pyramidal plates all laid out on a spheroidal surface. Very careful scrutiny however indicates some intriguing aspects. First of all, it appears that in general the pyramidal plates are laid out so that any six fit together in a basic hexagonal pattern. However there seems to be a larger scale pattern involved as one can discern lines between the plates that seem to curve at about three angles across the surface. Some of the

lines (geodesic lines related to the shortest distance paths that planes travel around the globe) seem to home towards a particular spot about half way from the centre of the dome to the 12 o'clock position. At that point there is a set of five plates laid out in a pentagonal arrangement. See if you can find them. In a complete sphere there would be twelve such pentagonal sets but only this one is visible on the photograph. What you see here is a fundamental "Mathematical Law of Nature" in action: An array of hexagons may only close into a sphere if twelve pentagons are included and the most familiar example is of course the modern soccer ball.

Fig 6 shows an image of a most fascinating geodesic dome – the Epcot Centre here in Florida. A soccerball which consists of 12 pentagonal patches and 20 hexagonal ones is constructed on the basis of the same geometric principles. There is a fundamental mathematical principle underlying the structure which governs all spheroidal structures form geodesic domes to soccerballs and from the tiling on the back of a turtle to the segments in the eye of a fly.

How the Internet Revolution has changed the Educational Landscape

Now some 15 years ago I initiated my Vega Science Trust project in the UK to enable scientists to communicate directly with the public and other scientists on all sorts of issues from those that fascinated them to those that concerned them. It all started when I gave a Friday Evening Discourse at the Royal Institution in London. These discourses go back a long time to when Humphrey Davy and later Michael Faraday were directors in the early part of the 19th Century. This was an early effort to apprise the citizens of London of the way the new culture – Science – was revolutionizing all aspects of the 19th Century World. It was in his research laboratory at the Royal Institution that Faraday invented the first electric motor and the first electricity generator. The discourses continue to this day and Faraday's laboratory is still there, much as it was when he died. One story that I remember hearing - but have yet to confirm - is that Lord Byron together with Mary and Percy Bysshe Shelley were representative of the sort of people who would attend the discourses and indeed they soon became a major event in the city. As the multitude of carriages descended on the Royal Institution located at the top of Albermarle St, just off Piccadilly, the jam was such that the street was turned into a one-way street – I understand the first in London. During one such discourse, which often were lectures with practical demonstrations, the lecturer passed an electric current through a corpse and as it

quivered the audience was led to believe that electricity was the stuff of life. It was this demonstration which Mary Shelley may either have seen or perhaps heard about through the writings of Humphrey Davy that probably was the seed for her most famous novel tell the story of Dr Frankenstein.

Since those times television has brought about a revolution in information dissemination and I started an effort to record the discourses for broadcast on the BBC. This effort became the Vega Science Trust which has produced about 300 programmes of which some 70 have been broadcast by the BBC. All the programmes can be watched free on the www.vega.org.uk website. However just as TV revolutionized the dissemination of audio-visual information, so in the last few years the Internet has given birth to another much greater revolution. Indeed as far as education is concerned it has the possibility of providing a massive paradigm shift. On the backs of the computer hardware, software and Internet technical advances pioneered by companies such as IBM, Microsoft, Apple, Cisco and Sony etc a fascinating new world has been born. I call it The Goo-You-Wiki World or GYWW. GYWW is a triple revolution: a) Google has shifted the paradigm in finding and accessing information, even deeply embedded material. It can mine websites efficiently and find material that might be difficult to locate by going directly to the website. b) YouTube has freed film makers from the tyranny of the film and TV industry; it has democratized film-making and the dissemination of moving images. Individuals can now make their own films and have millions of people see them. Perhaps most amazing from an educational standpoint is Wikipedia, c) Jimmy Wales has liberated the creative potential of some half-a-million or so individuals and enabled them to altruistically contribute outstanding educational material to a globally accessible cache. These people contribute material that they may have spent a lifetime accumulating, assimilating and trying to understand and they are contributing to an ever-growing cache of globally accessible educational material on subjects that are their personal passions. Analysis indicates that it is apparently 90% reliable. This is without doubt the greatest contribution ever made to general education.

These new possibilities have been the inspiration for the Global Educational Outreach for Science, Engineering and

Technology (GEOSET) project which we are now pioneering from Florida State University in the US and Sheffield University in the UK and it is now starting to take off. Initially I set up a studio with the technical help of David Simpson here at FSU. The studio is a small room just off my laboratory and there is a similar one in the Kroto Research Institute at Sheffield University where the sister site is located. With the help of my colleagues Colin Byfleet, Steve Acquah and Penny Gilmer at FSU as well as great help from TA (Teaching Assistants) Don Brattan and now Sam Rustan we have developed a suite of educationally motivated strands.

Gradually it became clear how the scheme might advance and that is to encourage other educational institutions and organizations to work with us and so build up a network of participating nodes with related educational outreach aims but still maintain the intrinsic flexibility to allow each node to follow their own instincts. As well as the nodes here at FSU and Sheffield in the UK we now have GEOSET partners at Toyo University in Japan, Brighton University in the UK and the Institute Rudjer Boskovic in Croatia. We have also started to receive contributions from Harvard University as well as Ohio State University. We are also setting up links to the Hong Kong Technical University. A young educator Alex Fonseca in Brazil has made a colossal effort and has created a contributing website on which he has placed all the worked answers to the basic mathematical problems for the Brazilian Schools mathematics curriculum – in Portuguese of course. Just a few weeks ago the Universitat Politecnica de Valencia has indicated they are going to join in the endeavor as has the University of Concepcion in Chile. This will give a great boost to our foreign language educational initiatives and in this case a major advantage for the Hispanic students in general and in Florida in particular.

So exactly what are we doing? Well, it has become clear that the future of education must involve an overall dynamic structure which will enable teachers to work together in synergistically constructive combination. Over a period of just a dozen short years, the place of the encyclopedia as the primary (complete!) repository of the general knowledge acquired by the human race, has been displaced by the GooYouWiki World. Teachers and others search for the information they need using search engines such as Google, Bing etc. and locate images

via image browsers. Indeed one can almost instantaneously locate the image data one might need for teaching. The extra information that is useful to construct some component or other of a specific lesson may often be quickly located using Wikipedia and images via the Google image browser. The links provided offer a crucial reliability check. Video footage can be extremely useful in the classroom and often may be readily downloaded from YouTube. An example here that I used recently was some film of the Tacoma Narrows bridge collapse which was a graphic, real-life, example of the general phenomenon of vibrational resonance. It is even more important in quantum mechanical situations – for instance in the way carbon dioxide contributes to the "Greenhouse effect."

With my FSU colleagues Colin Byfleet (now returned to the UK) and Penny Gilmer as well as Steve Acquah in the Chemistry Department of FSU we have started to create recordings using what I call GYW-W 2.0. The teacher records a focused concept module in which a specific scientific concept is addressed. Teachers all over the world have developed clever ways to make complicated ideas and concepts interesting and understandable and we now have the technology to capture the way they do it. Until now the genius of the teacher has been lost when a teacher has retired – this need no longer be the case as we now have the technology to capture all examples of teacher wisdom for the edification of the next generation of teachers and we no longer need to invent the teaching wheels individually. With a camera and a computer we can capture the way the teachers personally describe a particular concept and syncronise it with their demonstration or technical data. In the sciences it has now become essentially de rigeur to give lecture presentations with simultaneous projection of data using either such slide software as Powerpoint or film. Much material is already available - it just needs to be repackaged in concept-focused modules which can be efficiently located by existing search software.

With modern capture station technology such as Mediasite, Echo 360 etc. or cloud-based remote-upload systems such as Tegrity it is now relatively straightforward to capture presentations for web-based dissemination either in real time or stored for streaming as-and-when a viewer requires it. One can use systems such as Microsoft Producer to edit the material for streaming.

A wealth of material is already available in this dual window format from short focused demonstrations to whole seminar presentations as well as complete lecture courses. The latter two are useful for the students on the associated courses and for individuals who are committed to learning about a specific subject in detail. However interspersed within the lectures are the nuggets of ingenious educational ideas and they need to be mined easily so that other teachers can learn from them and use the ideas in their own presentations. No one has the time to wade through the millions of hours of recorded material to locate the nuggets that would be useful for their own teaching courses. The answer is to somehow repackage as much specific conceptual material as possible in readily locatable and quickly accessible chunks; and that is what GEOSET is doing. GEOSET is assembling a cache of recorded concept-focused teaching modules which in general might only be as short as one minute or longer, preferably no longer than 5-8 minutes. To summarise the aim is to store as many concept modules as possible and make them easily located and readily available and above all free to all teachers wherever they are in the world.

My colleague then in Chemistry at FSU, Colin Byfleet, threw himself into the exercise and created a whole range of teaching modules ranging from concepts in mathematics modules to experimental physics projects. Penny Gilmer also in the Chemistry Department worked on a set of programmes for teachers and we were on our way. Then, as luck would have it, one day I asked the young researcher in the next office, Prajna Dhar, a PhD student who was doing some very interesting work with magnetic particles if she would record a module for GEOSET. I told Prajna to present her research project in a way that would be understandable to young 16/17 year pre-college students at high school so they could get an idea of what one can do at University and get enthusiastic about science. I struck gold as Prajna was delightful, her personality came over beautifully and she was able to explain her research so clearly that young people would be drawn along by her infectious personality and the enthusiasm that she was able to impart. Then a few weeks later Prajna asked me for a reference for the post doctoral fellowship and then I realized I could use the URL for her recording in the reference and the prospective employer could see her presentation, instead of relying only on my

word submerged in her pile-of-paper resume. The recording conflated with the written resume document to highly synergistic effect. I realized that this was a "no-brainer" and that in time this would become a de rigeur requirement, at least for short-listing, within the scientific community.

Steve Acquah, who came with me from the UK to help set up a research programme, turned out to be also highly talented at creating recordings. He is as innovative as he is technically capable and also adept in performing himself. He is presently ably aided and abetted by TA Sam Rustan. As an example Steve devised a highly imaginative recording in which he created a short movie of himself as a secret agent using software that made the movie look like a scratched old time one. He used this as an introduction to a more technical explanation of how youngsters might make some simple invisible ink from ingredients in the kitchen – a real hands-on demonstration exercise.

My retired chemistry colleague Russ Johnsen told me about his early experience with penicillin and I just had to get this on record so kids in the future might be able to appreciate the wonder that is penicillin. This has started a strand to record historical recollections such as those of Russ one of the first people after World War II to have benefitted from the availability of penicillin. It is not well known that although Alexander Fleming had originally noted the antibacterial properties of penicillin he did not do anything with his discovery and no progress was made until some ten years later. Around 1940 large numbers of soldiers died due to bacterial infection rather than the primary wounds they had suffered and in an attempt to combat this the team of Howard Florey, Ernst Chain and Norman Heatley probed the medical possibilities of Fleming's spore and it was through their efforts that penicillin was developed as the most powerful weapon we have against bacterial infection. So was born the field of Antibiotics. As Russ explains, if in 1946 penicillin had not been available his arm would have had to have been amputated to save his life.

Then I had what turned out to be a brainwave; I was teaching a general science honours course at FSU which gave me a lot of freedom to work with the young students and I decided to award one third of the course marks for a GEOSET recording on a science project of their own choice (Fig 7.)

A key factor of this brainwave was the enthusiasm that the idea generated. All the students threw themselves into the project and all the recordings were excellent and several quite outstanding. I discovered to my surprise that most young people were capable of making extremely worthwhile educational contributions.

Fig 7 Undergraduate Student Vinni LaBarbera presents a teaching module on his passion "Beetle." There are more than 350,000 species of beetles known so far.

The secret was that the primary factor needed was enthusiasm for the particular topic and that detailed teaching experience, though important, was not sufficient. All the students put in extra time to make sure their particular presentation was the best it could be. If I have discovered one thing as a teacher: By far the most important quality that a student needs to develop is the desire to never put in a second rate effort. If a student is satisfied with second rate effort I advise them to try to find something else to do for which only their best shot will give them personal satisfaction. This is a good recipe for future success as a citizen who can contribute to society. I think that one problem today is that young people are growing up in an artificial environment in which celebrity status and financial factors are deemed more important than the development of cultural creativity or the desire to make societal contributions. The GEOSET project has turned out to be a catalyzing influence for a more humanitarian attitude and citizenship-oriented philosophy. I was back in our home in the UK when all the student recordings were completed and I was able to view them at my leisure. Never was the grading of student work so enjoyable. In this way GEOSET has revolutionized student grading making it easy. Instead of wading through piles of paperwork it has become an effective assessment method and furthermore an enjoyable exercise (Fig 8.)

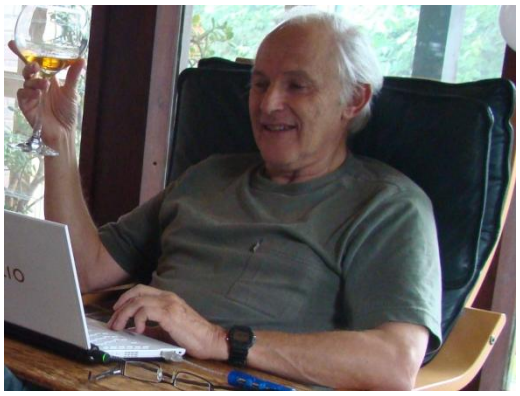

Fig 8 Here I am in our home in the UK tackling the arduous job of assessing the recorded project reports of the students on my honours course streamed on the Internet from Florida State University on www.geoset.fsu.edu and via the gateway site www.geoset.info

There are a number of ways in which the participating individual and institutions may contribute. In general we use a capture station which is basically a dedicated computer system which syncronises a video recording of the presenter together with the data file – in general a PowerPoint presentation Fig. 7. The target is the teacher who can use the material either directly in the classroom or preferably use the idea and present it themselves in the classroom. Of course students can watch the material themselves. In the past the greatest ideas that teachers have had were lost when a teacher retired unless one of their pupils remembered it and used it to teach the next generation. In this way we give the teacher some immortality at least as far as their way of teaching is concerned and of course their personality is saved too. I happen to like talking heads especially if allied to well-designed data in the second window – the way that GEOSET does it. Our aim in due course will be to make the data files downloadable too and usable directly by the teacher. We are now even getting contributions from high school students. The first was by Philip Schlenoff a young local Tallahassee student keen to create a module about his research project and we also have contributions from a very young group of Florida school kids called Nicky and the Geeks led by Nicky Chiarullo.

We have set up a GEOSET "Hall of Fame" detailing the success of students who have contributed to GEOSET: Kerry Gilmore GS –Has just been awarded a Fulbright Scholarship – to Italy 2010; Prajna Dhar GS – Was the first graduate to be recorded and her Geoset URL helped her to obtain the postdoctoral fellowship she wanted and ultimately to four tenure track offers. The University whose offer she has accepted commented that her presentation on Geoset indicated she could teach; Steve Acquah PDF – who, with Sam Rustan, runs the FSU Geoset programme produced the Geoset overview that won Geoset a Rich Media Educational Award 2009; Jeffrey Whalen

UG – writes: “Recording my presentation was really fun and I think it helped me get my present job. I appreciate being a part of what you are creating with Steve and the others! Thanks”; Artrease Spann GS – won a Florida Gubernatorial Scholarship. At interview she was told how much the committee enjoyed her Geoset presentation; Brittany Raffa UG who recorded a GEOSET presentation on benchmarking the Italian health care system was accepted by Dartmouth Medical School! She writes “The opportunity to do the presentation was a defining factor.” After her interview she emailed the URL of the presentation.

One essence of GEOSET is its flexibility – It is important not to be too prescriptive as there are as many ways to teach as there are teachers and as many ways to learn as there are pupils. Although primarily aimed at teachers of course we encourage students and members of the lay public to access the material. These are early days and we are now rebuilding the website to enable it to grow more effectively by facilitating the way in which the gateway site can link directly to participating nodes. The aim is to increase the number of educational institutions and organizations and individual accredited educators prepared to chip in material free and in this way we shall gradually cover all the educational bases. There is not a single front on which the project does not have some positive contribution. Finally what is most gratifying is the fact that Joe Travis formerly the Dean of Arts and Science and Eric Barron the new President are so positive and encouraging with regard to this effort. Probably the most satisfying aspect has been the way in which students can be the source of educational material as GEOSET is a vehicle which can convey the enthusiasm of young people in a way that conveys not only the essence of the subjects about which they care but also their personal enthusiasm, personalities and charm. Particularly important in this context has been the way the GEOSET project has invariably helped them to develop these important personal qualities and expand and further their interests.

Acknowledgements

I wish to thank may people for helping to make our move to Florida so painless and fruitful: Naresh Dalal and Alan Marshall and most members of the Chemistry and Biochemistry Dept at FSU. My student colleagues Prashant Jain who graduated last year and is now at Los Alamos National Lab and Darryl Ventura has just graduated. Paul

Dunk has just made a nice breakthrough in what turned out to be a very difficult problem and Artrease Spann who is about halfway through her doctoral course. Steve Acquah came with me from the UK as a postdoctoral researcher to help set up the research programme and with his innately positive outlook has steered the Nanoscience and Nanotechnology portion of the research programme and helped immensely with GEOSET. Sam Rustan is helping with GEOSET too. Colin Byfleet and Penny Gilmer have also provided vital help in setting up GEOSET. Last but not least Don Foss and Sandy d'Alembert for being so encouraging at the start.