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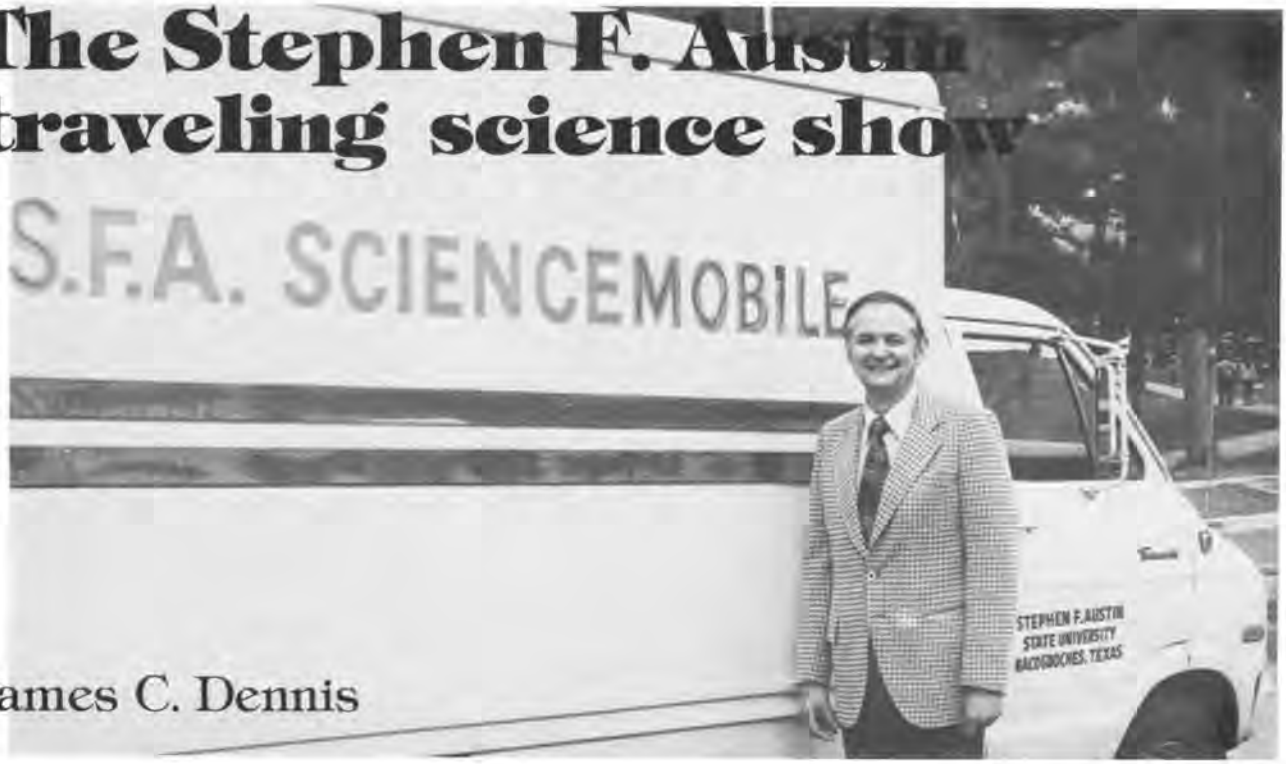

James C. Dennis

Dr. Glen T. Clayton, Dean of the School of Sciences and Mathematics, and the Stephen F. Austin Sciencemobile.

The early seventies were not good years for university physics departments, and the physics department at Stephen F. Austin State University eased into that period facing an uncertain future. Our enrollment had stabilized. We took small comfort knowing our experience was not unique – indeed the ruts in our road to old-age security seemed insignificant compared to roadblocks other physics departments were encountering. In 1972, however, the curves that we fitted to enrollment trends were characterized by slightly negative slopes, and numbers suddenly became our most pressing problem, a problem which continued to plague us for several years.

In 1972 the fortunes of the department took a definite upturn following a brief encounter with Dr. Alan Portis and the start of a long association with Dr. Glen T. Clayton, Dean of the School of Science and Mathematics. Dr. Clayton assumed his duties as Dean in May of 1972. Dr. Portis, then Director of the Lawrence Hall of Science at Berkeley, came to the department as a National Science Foundation Consultant in February. He suggested we take more interest in the physics being taught in the secondary schools in East Texas. Dr. Portis recommended, "I am sure that the department will now want to pay more attention to strengthening physics instruction in the (high) schools. I understand that up until now there has been relatively little contact between your department and the physical science teachers in the schools of East Texas." He suggested that we develop a traveling demonstration show to take to regional schools for a half-day or a full day at a time. A traveling show might be far more effective than one available only to students who could visit the campus, but we thought that a project of this nature would be too much for the resources of the department, and the returns on our investment in time and money would not justify the effort. However, we gave serious consideration to the possibility of establishing an on-campus demonstration show and an off-campus visiting lecture program.

Late in the spring we began sending newsletters to about one hundred high schools offering to bring lectures with a few demonstrations to their physics and physical science classes. Response was very encouraging, especially to the demonstrations. Our limited venture convinced us that Dr. Portis' philosophy of involvement was worth the time and money we had spent.

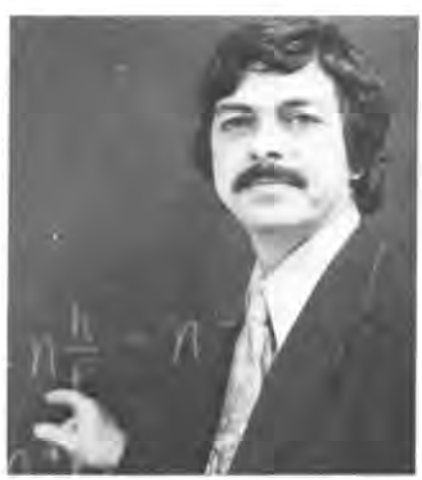

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Fig. 1. Student helper operating Fourier Wave Analyzer. Permanent spectra are etched into the graphite coated paper on top of the instrument.

Fig. 2. Obviously skeptical student on the bed of nails. There are 2600 No. 20 nails punched into pre-drilled holes in the "bed." Notice the double two-by-four liner surrounding the nails.

Getting it together

In the summer of 1972 I began constructing demonstrations for both on-campus and off-campus shows. Large, excessively delicate, or potentially dangerous pieces of equipment were to remain on campus, otherwise the demonstrations were to be featured in both programs. It was my goal to assemble a group of demonstrations that would appeal to all high school students, even that majority which considers itself allergic to physics. At my disposal were an excellent machine shop and an electronics shop within the physics department, some usable equipment already on hand, and a graduate student helper who was an excellent designer and builder. I selected demonstrations for their entertainment and educational value in that order. Most had to be easily operable and fairly indestructable. Exceptions were made in some cases for pieces of equipment operable only by the show personnel, for example, the complex Sonogram type Fourier analyzer used to make voice-prints (Fig. 1). The demonstrations that we constructed for the show included a rotating table, an air table, a double pendulum art machine,[1] a bed of nails (Fig. 2), a vibrating plate driven by a 100-W amplifier, a gas-burning tube for standing wave demonstrations, a very unusual flame detector, a solar engine,[2] a Tesla coil[3] (Fig. 5), a reaction timer (actually a fast-draw machine) (Fig. 6), a large electromagnet,[4] a Jacob's ladder, and an electromagnetic levitator.[5] Plans for the reaction timer in digital form are being drawn up and will be made available to anyone interested. Some of the off-the-shelf devices chosen for the show were a Van de Graaff generator, oscilloscopes, the Fourier wave analyzer already mentioned, an electrocardiograph, the Cenco microwave apparatus, an ac electromagnet, a vacuum system for several low pressure demonstrations, and a digital-frequency counter and voltmeter.

The flame detector uses an ultraviolet-sensitive quartz avalanche tube that is not generally available. I am presently searching for a source of these devices. The detector can sense a match flame at 100 ft in a hallway. The digital-frequency counter is used with a discriminator to measure voice frequencies, and the digital voltmeter is used with a selenium photocell and an op amp circuit as a "people detector." The slightest motion in a room changes the shadow pattern and the voltmeter reading.

Getting out on the road

Having assembled the show, I turned my attention to the problem of getting attention. I visited a number of high schools, some as far away as Houston, always checking with the school principal first for permission to bring the show at a later date and then arranging the date with the local physics teacher. Before leaving, I selected a suitable room, usually a large laboratory with tables and electrical outlets at each table. A lab with no windows was preferred. Every administrator and teacher contacted was enthusiastic about our return, particularly after I explained the format.

The format for the show

Rather than present the show in an assembly (shoot-and-run), as is customary, I elected to use an open-lab, come-and-go, hands-on format. The physics teacher involved was asked to arrange a schedule that would allow the maximum number of visitors in a single day. When a large school was visited I usually suggested that the periods be split so that two groups could participate in each period, but the final arrangement was always left up to the teacher in charge. In this way as many as 1200 students visited the show on some days. Throughout the day students were allowed to interact with the demonstrations and were invited to ask questions.

Fig. 3. The Van de Graaff generator and student.

Fig. 4. Bicycle wheel on rotating table with student demonstrator. The rotating table is made from a cast-off axle.

A typical day on the road

Many work days with the show were 16 hours long, including travel time. The exhausting nature of the effort mandated a Friday date for nearly all of the trips. An account of a day in the life of a college physics teacher bent on self-destruction follows.

Step 1. Load up the Sciencemobile (discussed below). The Chemistry Show visited Chemistry Clubs on Thursday nights and often returned very late at night, so this job was done under pressure!

Step 2. Leave at 4:00 A.M. for distant school and arrive at the site at 7:00 A.M.

Step 3. Set up the show. Even with graduate-student help at least an hour's lag time was necessary to get everything operating.

Step 4. Operate the show for groups of 50-200 students at a time at 30-minute intervals for the entire school day with a 15-to 30-minute lunch period as the only break. Answer questions and make on the spot repairs to damaged equipment whenever possible.

Step 5. Load up the equipment, checking to see that all pieces were retrieved.

Step 6. Arrive back at the campus at 7:30 and unload.

Step 7. On Monday assess the damage to the equipment and make repairs.

Step 8. On Wednesday call the next school to be visited to reaffirm the date.

Step 9. Every fourth or fifth week take Friday "off" to visit three or four schools for the next series of appointments.

If you are interested

First let me suggest that more than one faculty member should be involved. The show finally became too much for me to handle, and I had to cut down on appearances and participating numbers at each school. Secondly, administrative support is necessary so that class schedules of the sponsoring faculty members can be arranged to accommodate the program and so that funds for equipment and parts are made available. Next, use student helpers in every phase of the program, if good ones are available. Two of my assistants (graduate students) were nearly indispensable for the first two years of the program, and their graduation nearly brought the show to a close. Next, I suggest that the faculty sponsors should be extroverts, capable of communicating informally (kidding-around) with high school students. Finally, I suggest that the sponsors not overload themselves. A project of this nature can easily dominate someone's workweek.

Transportation

The first year of our show was known as the "We'll get there somehow" period. University station wagons, carryalls, pickup trucks, and even personal vehicles took us to the site. Beginning with the second year, permanent transportation was assured when Dr. Glen T. Clayton, Dean of the School of Science and Mathematics, purchased a Dodge Maxivan for the traveling program with an NSF grant. The van has the words "Stephen F. Austin Sciencemobile" painted on its sides

Change of Format

After three very successful years, having visited 60 high schools, many several times, and after having involved approximately 40 000 students, I decided to make the

Fig. 5. Tesla coil demonstration. This version is too dangerous to take off campus. A smaller harmless Tesla coil (see reference) was constructed to take off campus.

Fig. 6. The reaction timer. The 1/10-second clock is on back of the timer. The updated version presently under construction is all digital and will have all the electronics facing the student.

program less time-consuming by limiting it to physics students only. Exceptions are made for small high schools with 500 or less students which normally have only one small physics class or none at all. In such a case we expose the entire school to the show. Physical science classes in large schools are no longer eligible to attend because physical science is required in Texas high schools and as many as a thousand or more students in the larger schools are taking physical science simultaneously.

Support

The administration of the university has endorsed our program to the extent of its legal capability. No state university funds can be allocated to such a program regardless of its worth. The dean of our school, Dr. Clayton, has been our most enthusiastic advocate, and he has provided us not only with transportation but also with moral support whenever it was needed. He also has extended himself beyond the campus, visiting many elementary schools in our area to talk with students and to give physical-science workshops for their teachers.

Results

In the course of talking to thousands of high school students we were making our department and our university known to our visitors. Has the program been successful in drawing students to Stephen F. Austin to major in physics? We think so. In the spring of 1973 we had 9 majors and 16 minors. In the spring of 1977 we counted 42 serious majors and 75 minors. The quality and motivation of our majors has improved substantially and we are now expecting a corresponding upswing in our graduate program as our majors graduate and become candidates for the Master's degree here.

A schoolwide visitation program

Other departments in the School of Science and Mathematics have followed our lead and have instituted visiting programs of their own. The chemistry department has a lecture-demonstration show that has become very popular in East Texas. Everyone at Stephen F. Austin who has made a presentation off campus agrees that the time was well spent, and that a coordinated campus-wide visitation program should be our next goal.

Where we are now and where we are headed

The SFA Traveling Science Show has branched into three separate presentations. The two additional ones are the SFA $1.98 Magic Show and the SFA Psychedelic Light Show. The former consists of simple inexpensive demonstrations requiring no equipment, which can be added to the repertoire of any physical-science teacher. Many elementary schools in our area have self-contained classrooms and thus nearly every teacher of grades one through six could benefit from a presentation of the $1.98 Magic Show, and many already have. The Psychedelic Light Show, consisting of numerous fascinating kinetic light effects accompanied by electronic music, is seldom taken off campus. Thousands of visitors, young and old, recently enjoyed the Light Show during the Annual Open House of the Edwin L. Miller Science Building on our campus.

I would like to recommend my program to any physics department facing enrollment problems. The cost in dollars of assembling The Stephen F. Austin Traveling Science Show was nominal, and anyone interested in off-campus visitation should be able to implement his own show for a few hundred dollars. Bear in mind that semi-unsupervised high school students can inflict a lot of punishment upon expensive, delicate equipment, so rugged inexpensive devices like the bed of nails are ideal. High school teachers, harried, hounded, underpaid, and under-equipped, are sincerely appreciative of any help they can get, especially from neighboring universities. Good high school teachers are influential and their recommendations are taken seriously by their students. Good high school teachers make good friends, and good friends are not easily made.

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