Project Title: Student Science Training for High Ability Secondary School Students

Project No: E-27-524

Principal Investigator: Dr. J. L. Lundberg

Sponsor: National Science Foundation

Agreement Period: From 2/15/75 Until 10/31/75

Type Agreement: Grant No. EPP75-06229

Amount: $21,170

Reports Required: Student Participation Information Sheets; Director's Final Report

Sponsor Contact Person(s):

Administrative Matters thru ORA
Mr. Gaylord L. Ellis
Grants Officer
National Science Foundation
Washington, D. C., 20550
(202) 632-5965

Assigned to: Textile Engineering

COPIES TO:
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- School Director
- Dean of the College
- Director, Research Administration
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- Security-Reports-Property Office
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- Project File
- Other

RA-3 (6-71)
GEORGIA INSTITUTE OF TECHNOLOGY
OFFICE OF CONTRACT ADMINISTRATION
RESEARCH PROJECT TERMINATION

Date: January 5, 1976

Project Title: Student Science Training for High Ability Secondary School Students

Project No: B-27-524

Principal Investigator: Dr. J. L. Lundberg

Sponsor: National Science Foundation

Effective Termination Date: 10/31/75

Clearance of Accounting Charges: 12/31/75

Grant/Contract Closeout Actions Remaining: Final Fiscal Report (OFA/FEI)

Grant No. EPP 75-06327

Student Science Train. for HI. Ability Secondary Sch. Stu.

No Cost Required on NSF Grants

Assigned to School of Textile Engineering

COPIES TO:

Principal Investigator
School Director
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Office of Financial Affairs (2)
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Office of Computing Services
Terminated Project File No. B-27-524
Other
FINAL REPORT

1975 National Science Foundation Student Training Program
in
Polymer, Fiber & Textile Science & Engineering
at the
Georgia Institute of Technology
June 15 - August 1, 1975

- Abstract -

Thirty-seven students from 29 high schools in six states worked on 38 research projects with 39 research advisers from eight different schools or departments at Georgia Tech. Studies were interdisciplinary or multidisciplinary for the most part. Disciplines, materials, and activities represented are as follows: chemistry (20 projects), engineering (15), textiles (12), polymers (8), physics (6), life science (6), the environment (5), fibers (5), ceramics (4), computing (3), medical engineering (3), energy (2 projects), and nucleonics and transportation one project each. Good results, structures, materials or data, were produced in about half of these projects; some of the results will be published.

Student participants attended 44 seminars in which science, engineering and mathematics were taught without separation into disciplines. Our macromolecular environment was emphasized with discussion centered on polymers, fibers and textiles. Nine speakers from off campus or other schools at Georgia Tech presented eight colloquia; students enjoyed these most, particularly in retrospect. Thirteen optional seminars on mechanics, thermodynamics, quantum mechanics, statistical thermodynamics, and spectroscopy were offered along with five two-hour seminars on computers, programming and plotting, and twelve showings of 37 motion pictures on science. Two field trips, to an observatory, planetarium, museum, and nature preserve and to a polymer and fiber factory and a nuclear-hydroelectric complex were high points of the program. Eleven group social activities were provided.

Study of science, engineering, and mathematics without separation into subjects or disciplines is effective. Students benefitted from the diversity of research opportunities offered, unstructured work with much individual attention, catholic definition and treatment of science, and widely varied activities. The necessity to choose continually among many alternatives in academic and extracurricular activities on campus was a particularly valuable experience for these students whose experiences have been limited to rather rigidly structured schools offering few choices.

Submitted by: John L. Lundberg
NSF-SSTP Director
School of Textile Engineering
Georgia Institute of Technology
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I. Preparation

A. Advertising

The School of Textile Engineering prepared a brochure (Appendix I) for distribution before awards of grants were announced. These were distributed to all principals, counselors, and science and math teachers in public schools and many private and parochial schools in Georgia. Distributions were made by direct mail to the schools, through science coordinators in the larger systems and to teachers at their homes through listings by the Georgia Education Association and the Science Teachers Association. In spite of double coverage to most teachers and schools and triple coverage to the larger school districts many teachers are unaware of our program. In principle all of these schools and teachers received the listing of all SST programs distributed by the Foundation.

Mr. Dallas Stewart, Science Coordinator, Education Department of the State of Georgia, has been most helpful in 1973-75 in aiding us in contacting teachers, counselors, principals and school administrators. Thanks to his efforts we have been in contact with and participated in science programs of the regional resource centers in Georgia and in the Governor's Honors Program for high school students.

We advertised our program at science fairs, group meetings of students and/or teachers, and in our visits to high schools and talks for high school science classes. Mr. A. J. Maguire, III, recruiter and adviser for incoming students for Georgia Tech's School of Textile Engineering publicized our program in his visits to high schools in Georgia.
B. Selecting Students

Two hundred plus students inquired about our SST program. Sixty (60) students submitted applications. We accepted fifty three (53) of these as participants or alternates whom we would welcome into the program. Seven (7) of the applicants probably would have been harmed by trying to compete with the able participants in our program; these alternates were not called to fill vacancies.

Students selected themselves for our program. Only those who are seriously interested bother with the application forms and short essay. Most of the students who apply have sufficient desire and drive to succeed in our SST program. The same is true of applicants for admission to Georgia Tech. Only seriously interested, committed students come here; easier schools are accessible for those who just want to go to college. This reputation of Georgia Tech "rubs off" on our SST program.

With each year's experience we realize that we know less about selecting participants. We try to select on the following bases (in descending order of importance): 1. personal interviews with applicants, 2. telephone conversations with applicants, 3. statements in 300 words or less why the applicants wish to participate in the program, 4. face to face and telephone conversations with teachers, 5. class rank, 6. grades in high school courses, and 7. scores on standardized examinations.

Mr. A. J. Maguire, III, who was counselor for incoming students in the School of Textile Engineering from 1973-'75, and the program director interviewed about half of the applicants and talked to the others (except for
the Samcan) by telephone. Only on the basis of interviews could we accept students from the Atlanta city schools and in some cases from other communities in Georgia. For these students we found no correlation among the quality of students' written statements, teachers' recommendations, class rank, grades in courses, and scores on standardized examinations. To demonstrate the need for interviews in many cases, consider the data in Table I for selected applicants for our program.

Table I
Class Rank and Scores on Examinations for Selected Applicants

<table>
<thead>
<tr>
<th>Student No.</th>
<th>Class Rank%</th>
<th>Comp.</th>
<th>Math</th>
<th>Reading</th>
<th>Verbal(80)</th>
<th>Quantitative(80)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>95+</td>
<td>68</td>
<td>58</td>
<td>73</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>75+</td>
<td></td>
<td></td>
<td></td>
<td>30</td>
<td>41</td>
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<tr>
<td>3</td>
<td>90</td>
<td>43</td>
<td>46</td>
<td>41</td>
<td>21</td>
<td>26</td>
</tr>
<tr>
<td>4</td>
<td>98</td>
<td></td>
<td></td>
<td></td>
<td>22</td>
<td>34</td>
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<tr>
<td>5</td>
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<td>20</td>
<td>31</td>
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<td>6</td>
<td>96</td>
<td>47</td>
<td>40</td>
<td>41</td>
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<td>7</td>
<td>100</td>
<td>58</td>
<td>52</td>
<td>57</td>
<td></td>
<td></td>
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<td>8</td>
<td>98</td>
<td>50</td>
<td>54</td>
<td>54</td>
<td>34</td>
<td>45</td>
</tr>
<tr>
<td>9</td>
<td>90+</td>
<td>80</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>85</td>
<td></td>
<td></td>
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<td>27</td>
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<tr>
<td>11</td>
<td>100</td>
<td>52</td>
<td>50</td>
<td>51</td>
<td>31</td>
<td>46</td>
</tr>
<tr>
<td>12</td>
<td>98</td>
<td>58</td>
<td>58</td>
<td>62</td>
<td>37</td>
<td>58</td>
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<tr>
<td>13</td>
<td>94</td>
<td>61</td>
<td>50</td>
<td>51</td>
<td></td>
<td></td>
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<tr>
<td>14</td>
<td>80+</td>
<td></td>
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<td>27</td>
<td>39</td>
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<tr>
<td>15</td>
<td>62</td>
<td></td>
<td></td>
<td></td>
<td>46</td>
<td>53</td>
</tr>
</tbody>
</table>
Students numbers 1-13 are from Atlanta, the others from elsewhere in Georgia. On the basis of examination scores, none of these students should have been considered for the program. According to their rankings in their classes in relatively large high schools, eight or nine of the fifteen should be eligible. Students 8-15 participated in the program. Of these numbers 8-13 did good (grade = 2.0 or C) work in their research, number 14 did superior (grade = 4.0 or A) research, and number 15's performance was better than excellent (grade > 3.0 or B).

Of the sixteen (16) students whom we accepted as participants or welcome alternates and who did not participate in our SST program, four (4) attended other SST programs, one was ill and could not attend, we could not arrange transportation from American Samoa for one candidate, and we had insufficient funds to support four (4) students who applied late. Six (6) students decided not to participate because they found summer jobs and needed money.

C. Soliciting Funds

We asked textile, fiber, carpet, and chemical manufacturers for financial help with the program. In this year of recession only $1500 was contributed by two corporations. Last year we received $7600 from ten companies. We hope that we can do better in 1976.

II. Participants

A. Profile

We compare our SSTP participants to our undergraduate students at Georgia Tech. About ninety percent of these are engineering and science majors with the majority in engineering. The average SAT score is about 1200. Compared to
these undergraduates, we rate as good (with grade = 2.0 or C) those SSTP applicants whom we would welcome as undergraduates. With this frame of reference, our estimates of the participants and other applicants before the start of the program is given in Table II.

Table II

Estimated Potential for Research Performance of Participants and Other Applicants to Georgia Tech's 1975 SST Program

<table>
<thead>
<tr>
<th></th>
<th>Gifted (4.0=A)</th>
<th>Good (3.0=B)</th>
<th>Good (2.0=C)</th>
<th>Fair (1.0=D)</th>
<th>Poor (0.0=F)</th>
<th>Totals</th>
<th>Number</th>
<th>Avg.Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>Participants</td>
<td>2</td>
<td>5</td>
<td>19</td>
<td>7</td>
<td>4</td>
<td>37</td>
<td>1.83</td>
<td></td>
</tr>
<tr>
<td>Limited opportunity</td>
<td>0</td>
<td>3</td>
<td>12</td>
<td>4</td>
<td>4</td>
<td>23</td>
<td>1.68</td>
<td></td>
</tr>
<tr>
<td>Other applicants</td>
<td>2</td>
<td>5</td>
<td>7</td>
<td>4</td>
<td>6</td>
<td>23</td>
<td>1.70</td>
<td></td>
</tr>
<tr>
<td>Limited opportunity</td>
<td>0</td>
<td>4</td>
<td>5</td>
<td>3</td>
<td>6</td>
<td>18</td>
<td>1.39</td>
<td></td>
</tr>
</tbody>
</table>

At least twenty-three (23) of the thirty seven (37) participants have had limited opportunity to study and work in science. Further description of the group is given by the following data:

Number of girls 13
Number of boys 14
Number of members of "minority groups" 12
Number from inner city 10
Number from smaller cities 16
Number from suburbs 4
Number from small towns and rural areas 7
Number from Georgia 25
Number from other states 12
Number with good to superior over-all opportunity 14
Number whose opportunity could be improved 23
B. Names, Addresses, High Schools of Participants

Steven Bishop
Box 122B, Route 2
Fitzgerald, GA 31750

Vicent Bradford
1074 Rigdon Road
Columbus, Georgia 31906

Ed Brooks
205 Cherry Hill Drive
Calhoun, Georgia 30701

Jennifer Buchanan
7104 W. 101st Street
Overland Park, Kansas 66212

Janice Character
625 Center Hill Avenue
Atlanta, Georgia 30318

Robert J. Clopp
122 Westbury Drive
Huntsville, Alabama 35802

Barbara Ann Combs
Route 2, Box 195
Greenville, Georgia 30222

Earl Thomas Craft
3121 Bellanca Street
Columbus, Georgia 31904

Scott Dean
2875 Pharr Road
Atlanta, Georgia 30317

Lee Dickenson
3319 Oakridge Drive
Augusta, Georgia 30904

Bobby Dye
126 Westfiled Road
Leesburg, Georgia 31763

Irwin County High School
P. O. Box 106
Ocilla, Georgia 31774

Hardaway High School
2901 College Drive
Columbus, Georgia 31905

Calhoun High School
River Street
Calhoun, Georgia 30701

Notre Dame de Sion High School
10631 Wornall Road
Kansas City, Missouri 64133

West Fulton High School
1890 Bankhead Highway
Atlanta, Georgia 30318

Huntsville High School
2304 Billy Watkins Avenue
Huntsville, Alabama 35801

Greenville High School
P. O. Box T
Greenville, Georgia 30222

Columbus High School
1700 Cherokee Avenue
Columbus, Georgia 31906

Murphy High School
256 Clifton Street, S.E.
Atlanta, Georgia 30317

Academy of Richmond County
961 Baker Avenue
Augusta, Georgia 30904

Lee County High School
Leesburg, Georgia 31763
Mark Habeck  
1324 Martinique  
Augusta, Georgia 30904

Greg Hammett  
1715 Birchwood Lane  
Milledgeville, Georgia 31061

Agnes Hardeman  
129 Burbank Drive, N.W.  
Atlanta, Georgia 30314

Kim Harvey  
128 Cedar Hill  
Waverly, Tennessee 37185

Alice Jackson  
406 Archcrest Drive  
Atlanta, Georgia 30354

Peter Johnston  
4362 Wieuca Road  
Atlanta, Georgia 30342

Randy Jones  
Route 1  
Chula, Georgia 31733

James Kee  
1107 Hogan Street  
Augusta, Georgia 30904

Anthony Kehoe  
1080 Oak Street, S.W.  
Atlanta, Georgia 30310

Wayne Knecht  
3050 Briarcliff Road  
Apt. 8  
Atlanta, Georgia 30329

Virgil Lee  
P. O. Box 434  
Kingsland, Georgia 31548

Mark Mitchell  
303 Valley Drive  
Dalton, Georgia 30720

Academy of Richmond County  
961 Baker Avenue  
Augusta, Georgia 30904

Baldwin High School  
Milledgeville, Georgia 31061

Henry McNeal Turner High School  
98 Anderson Avenue, N.W.  
Atlanta, Georgia 30314

Waverly Central High School  
Box 500  
Waverly, Tennessee 37185

Walter F. George High School  
800 Hutchins, S.E.  
Atlanta, Georgia 30354

Galloway School  
215 West Wieuca Road, N.W.  
Atlanta, Georgia

Irwin County High School  
P.O. BOX 106  
Ocilla, Georgia 31774

Academy of Richmond County  
961 Baker Avenue  
Augusta, Georgia 30904

St. Joseph High School  
320 Courtland Street, N.E.  
Atlanta, Georgia 30310

Briarcliff High School  
2415 North Druid Hills Road, N.E.  
Atlanta, Georgia 30329

Camden County High School  
P.O. BOX 798  
Saint Mary's, Georgia 31558

Dalton High School  
P.O. BOX 2127  
Dalton, Georgia 30720
<table>
<thead>
<tr>
<th>Name</th>
<th>Address</th>
<th>City, State ZIP</th>
</tr>
</thead>
<tbody>
<tr>
<td>James Morrione</td>
<td>1407 Pine Ridge Road</td>
<td>Montgomery, Alabama 36109</td>
</tr>
<tr>
<td>Curlee Morriseette</td>
<td>931 Newsome Street</td>
<td>Prichard, Alabama 36610</td>
</tr>
<tr>
<td>Evanthea Parker</td>
<td>3670 Windermere</td>
<td>Montgomery, Alabama 36109</td>
</tr>
<tr>
<td>Dawn Pollard</td>
<td>507 Avenue E</td>
<td>West Point, Georgia 31833</td>
</tr>
<tr>
<td>Karen C. Potter</td>
<td>P. O. BOX 366</td>
<td>Florala, Alabama 36442</td>
</tr>
<tr>
<td>Scherita Quinney</td>
<td>2317 W. Main Street</td>
<td>Prichard, Alabama 36610</td>
</tr>
<tr>
<td>Lloyd Rieber</td>
<td>2412 Cobden Street</td>
<td>Pittsburgh, PA. 15203</td>
</tr>
<tr>
<td>Susan Rohrer</td>
<td>819 W. Eighth Street</td>
<td>Tifton, Georgia 31794</td>
</tr>
<tr>
<td>James R. Smith</td>
<td>3077 Laura Lane</td>
<td>Lithia Springs, Georgia 30057</td>
</tr>
<tr>
<td>David Tabby</td>
<td>7746 Clements Road</td>
<td>Wyncote, PA. 19095</td>
</tr>
<tr>
<td>Pamela Warbington</td>
<td>662 S. Grande Avenue</td>
<td>Atlanta, Georgia 30318</td>
</tr>
<tr>
<td>Sheree Warren</td>
<td>1401 Bankhead Hwy. Apt. #5-2</td>
<td>Atlanta, Georgia 30318</td>
</tr>
<tr>
<td>Robert E. Lee High School</td>
<td>225 Ann Street</td>
<td>Montgomery, Alabama 36107</td>
</tr>
<tr>
<td>Mattie T. Blount High School</td>
<td>838 West Main Street</td>
<td>Prichard, Alabama 36610</td>
</tr>
<tr>
<td>West Point High School</td>
<td>LaGrange Highway</td>
<td>West Point, Georgia 31833</td>
</tr>
<tr>
<td>Westwood School</td>
<td>Camilla, Georgia 31730</td>
<td></td>
</tr>
<tr>
<td>South High School</td>
<td>Tenth &amp; Carson Streets</td>
<td>Pittsburg, Pennsylvania 15203</td>
</tr>
<tr>
<td>Tift County High School</td>
<td>West Eighth Street</td>
<td>Tifton, Georgia 31794</td>
</tr>
<tr>
<td>Woodward Academy</td>
<td>P. O. BOX 87190</td>
<td>College Park, Georgia 30337</td>
</tr>
<tr>
<td>Cheltenham Senior High School</td>
<td>Riles Mill &amp; Carlton Avenues</td>
<td>Wyncote, Pennsylvania 19095</td>
</tr>
<tr>
<td>West Fulton High School</td>
<td>1890 Bankhead Highway</td>
<td>Atlanta, Georgia 30318</td>
</tr>
<tr>
<td>West Fulton High School</td>
<td>1890 Bankhead Highway</td>
<td>Atlanta, Georgia 30318</td>
</tr>
</tbody>
</table>
III. The Program

A. Research

The purpose of the program was to introduce students to research in science and engineering and to help them carry out research of some merit. About three quarters of time and effort were directed to that end. Thirty seven (37) student participants worked on thirty eight (38) research problems with thirty nine (39) research advisers from eight (8) different schools or departments at Georgia Tech. Decent, meaningful data and/or observations were obtained or structures and prototypes constructed in at least half of the projects.

Results will be published as parts of ongoing research. Names of students, titles of research problems and names and organizations of advisors are as follows:

<table>
<thead>
<tr>
<th>Students</th>
<th>Research Projects</th>
<th>Advisers</th>
</tr>
</thead>
<tbody>
<tr>
<td>2. Vicent Bradford</td>
<td>Creep of polypropylene and nylon 66 fibers</td>
<td>F.K. Ko (Textile Eng.)</td>
</tr>
<tr>
<td>Student</td>
<td>Research Projects</td>
<td>Advisor(s)</td>
</tr>
<tr>
<td>--------------</td>
<td>-----------------------------------------------------------------------------------</td>
<td>------------------------------------------------</td>
</tr>
<tr>
<td>4. Jennifer Buchanan</td>
<td>Physical properties of spider silks</td>
<td>F.K. No</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(Textile Eng.)</td>
</tr>
<tr>
<td>8. Tommy Craft</td>
<td>Crack propagation in fabric chutes for escape from aircraft</td>
<td>W.D. Freiston &amp; M.E. Sikorski (Text. Eng.)</td>
</tr>
<tr>
<td>9. Scott Jean</td>
<td>Drying of carpets using solar energy</td>
<td>W.D. Freiston (Text. Eng.) &amp; J.R. Williams (Mechanical Eng.)</td>
</tr>
<tr>
<td>10. Lee Dickenson</td>
<td>Purification of enzymes</td>
<td>S.W. Moy, R.S. Phillips &amp; C.W. Powers (Chemistry)</td>
</tr>
<tr>
<td>11. Bobby Bye</td>
<td>Design and construction of prototypes of beds for patients suffering from severe burns</td>
<td>A.J. Maguire (Text. Eng.)</td>
</tr>
<tr>
<td>12. Mark Huback</td>
<td>Preparation and characterization of proteoloids</td>
<td>R.N. Wartell (Physics)</td>
</tr>
<tr>
<td>13. Greg Hammett</td>
<td>Analysis of nuclear structures of Pt199 and Au200 by gamma ray spectroscopy</td>
<td>R.W. Pink &amp; W.S. Lewis (Chemistry)</td>
</tr>
<tr>
<td>15. Kim Harvey</td>
<td>Flame retardants for fabrics and carpets</td>
<td>W.C. Boteler, T.R. Henson &amp; L.R. Lloyd (Text. Eng.)</td>
</tr>
<tr>
<td>Students</td>
<td>Research Projects</td>
<td>Advisers</td>
</tr>
<tr>
<td>-----------</td>
<td>----------------------------------------------------------</td>
<td>-----------------------------------------------</td>
</tr>
<tr>
<td>17. Peter Johnston</td>
<td>Synthesis of polymers: anionic polymerization of caprolactam</td>
<td>W.C. Pincher &amp; L.R. Lloyd (Text. Eng.)</td>
</tr>
<tr>
<td>18. Randy Jones</td>
<td>Computer control of textile processes</td>
<td>L.H. Olson, (Text. Eng.) &amp; Cheryl Allen (Comp. Ctr.)</td>
</tr>
<tr>
<td>19. James Kee</td>
<td>Effects of $CO_2$ concentration on growth of plants in good soil and sand with nutrient solution</td>
<td>W.C. Carter (Text. Eng.)</td>
</tr>
<tr>
<td>20. Tony Kehoe</td>
<td>Crack propagation in fabric chutes for escape from aircraft</td>
<td>W.D. Freeston (Text. Eng.)</td>
</tr>
<tr>
<td>23. Mark Mitchell</td>
<td>Reinforcing concrete with textile fibers</td>
<td>J.F. Benzei, R. Fields &amp; T. Mackrovitch (Ceramic Eng.)</td>
</tr>
<tr>
<td>25. Curlee Morrisette</td>
<td>Ignition characteristics of fibers</td>
<td>W.C. Pincher (Text. Eng.)</td>
</tr>
<tr>
<td>27. Dawn Pollard</td>
<td>Reactive dyes on cellulose: effects of dying conditions</td>
<td>W.C. Carter (Text. Eng.)</td>
</tr>
<tr>
<td>Students</td>
<td>Research Projects</td>
<td>Advisers</td>
</tr>
<tr>
<td>----------</td>
<td>-------------------</td>
<td>----------</td>
</tr>
<tr>
<td>29. Scherita Quinney</td>
<td>Design and construction of prototypes of beds for patients suffering from severe burns</td>
<td>A.J. Maguire (Text. Eng.)</td>
</tr>
<tr>
<td>30. Lloyd Riefer</td>
<td>Strengths of materials at low temperatures</td>
<td>W.D. Freeston &amp; M.E. Sikorski (Text. Eng.)</td>
</tr>
<tr>
<td>31. Susan Rohrer</td>
<td>Development of a bed for burn patients</td>
<td>A.J. Maguire &amp; W.D. Freeston (Text. Eng.)</td>
</tr>
<tr>
<td>33. David Tabby</td>
<td>Comparison of membranes and fibers for reverse osmosis</td>
<td>W.C. Carter, W.C. Tincher &amp; J.L. Lundberg (Text. Eng.)</td>
</tr>
<tr>
<td>34. Pamela Warbingtton</td>
<td>Investigation of the effects of dyeing wastes on water</td>
<td>W.C. Tincher &amp; J.R. Robertson (Text. Eng.)</td>
</tr>
<tr>
<td>35. Sheree Warren</td>
<td>Development of a bed for burn patients</td>
<td>A.J. Maguire, W.D. Freeston (Text. Eng.)</td>
</tr>
<tr>
<td>37. Akiro Yara</td>
<td>1. Study of the impact on the public of rapid transit-MARTA 2. Use of small computers in the laboratory</td>
<td>D.O. Covault &amp; P. Costa (Civil Eng.) L.H. Olson (Text. Eng.)</td>
</tr>
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</table>
Research advisers for these students were as follows:

<table>
<thead>
<tr>
<th>Name</th>
<th>Degree</th>
<th>Position</th>
<th>School or Center</th>
<th>Specialty</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cheryl Allen</td>
<td>BS(Math)</td>
<td>Systems Analyst</td>
<td>Computer Center</td>
<td>Programming &amp; analysis</td>
</tr>
<tr>
<td>J.F. Bensel</td>
<td>PhD(CerE)</td>
<td>Assoc. Prof.</td>
<td>Ceramic Eng.</td>
<td>Refractory materials &amp; processing &amp; forming</td>
</tr>
<tr>
<td>W.C. Boteler</td>
<td>MS(ME)</td>
<td>Professor</td>
<td>Textile Eng.</td>
<td>Textile processing &amp; forming</td>
</tr>
<tr>
<td>C.W. Bowars¹</td>
<td>BS(Chem)</td>
<td>Res. Asst.</td>
<td>Chemistry</td>
<td>Biochemistry</td>
</tr>
<tr>
<td>W.R. Callen</td>
<td>PhD(EE)</td>
<td>Asst. Prof.</td>
<td>Electrical Eng.</td>
<td>Optical &amp; computer systems</td>
</tr>
<tr>
<td>W.C. Carter</td>
<td>PhD(Chem)</td>
<td>Professor</td>
<td>Textile Eng.</td>
<td>Polymer &amp; textile chemistry</td>
</tr>
<tr>
<td>A.T. Chapman</td>
<td>PhD(Cer.E)</td>
<td>Professor</td>
<td>Ceramic Eng.</td>
<td>Organic &amp; textile chemistry</td>
</tr>
<tr>
<td>F. Costa,Jr.</td>
<td>BS(CE)</td>
<td>Predoctoral Fellow</td>
<td>Civil Eng.</td>
<td>Transportation</td>
</tr>
<tr>
<td>D.O. Covault</td>
<td>PhD(CE)</td>
<td>Professor</td>
<td>Civil Eng.</td>
<td>Plastics Eng.</td>
</tr>
<tr>
<td>R. Fields</td>
<td>PhD(Chem)</td>
<td>Professor</td>
<td>Chemistry</td>
<td>Nuclear chemistry</td>
</tr>
<tr>
<td>R.N. Fink</td>
<td>PhD(NE)</td>
<td>Prof. Director</td>
<td>Textile Eng.</td>
<td>Mechanics &amp; textile eng.</td>
</tr>
<tr>
<td>M.C. Clawer</td>
<td>PhD(Chem.)</td>
<td>Post-doctoral Fellow</td>
<td>Textile Eng.</td>
<td>Textile &amp; polymer chemistry</td>
</tr>
<tr>
<td>A.L. Hines</td>
<td>PhD(ChE)</td>
<td>Asst. Prof.</td>
<td>Chemical Eng.</td>
<td>Textile &amp; polymer chemistry</td>
</tr>
<tr>
<td>F.K. Ko³³</td>
<td>MS(TE)</td>
<td>Pre-doctoral Fellow</td>
<td>Textile Eng.</td>
<td>Plastics eng. &amp; polymer science</td>
</tr>
<tr>
<td>W.S. Lewis³³</td>
<td>BS(Chem)</td>
<td>Pre-doctoral Fellow</td>
<td>Chemistry</td>
<td>Polymer science &amp; textile eng.</td>
</tr>
<tr>
<td>G.R. Lightsey</td>
<td>PhD(ChE)</td>
<td>Asst. Prof.</td>
<td>Chemical Eng.</td>
<td>Nuclear chemistry</td>
</tr>
<tr>
<td>J.L. Lundberg</td>
<td>PhD(Chem)</td>
<td>Calloway Prof.</td>
<td>Textile Eng.</td>
<td>Textile technology &amp; management</td>
</tr>
<tr>
<td>S.W. May</td>
<td>PhD(Chem)</td>
<td>Asst. Prof.</td>
<td>Chemistry</td>
<td>Biochemistry</td>
</tr>
<tr>
<td>J.A. Maynard³³</td>
<td>BS(EE)</td>
<td>Res. Asst.</td>
<td>Electrical Eng.</td>
<td>Optical &amp; computer systems</td>
</tr>
<tr>
<td>A.J. Maguire,III</td>
<td>MS(Text.)</td>
<td>Adm.Specialist</td>
<td>Textile Eng.</td>
<td>Textile technology &amp; management</td>
</tr>
</tbody>
</table>

¹ Graduated with highest honors in chemistry in June, 1975; first in class.
² Participant in Georgia Tech’s 1974 SSTP; early entrant at Tech in September, 1974; Boys’ Counselor in 1975 SSTP; Dean’s list 1974-75.
³ Graduate Student
⁴ Senior in Chemical engineering with working experience in plastics engineering.
<table>
<thead>
<tr>
<th>Name</th>
<th>Degree</th>
<th>Position</th>
<th>School or Center</th>
<th>Specialty</th>
</tr>
</thead>
<tbody>
<tr>
<td>J.D. Muzzy</td>
<td>PhD(Chem)</td>
<td>Assoc. Prof.</td>
<td>Chemical Eng.</td>
<td>Plastics eng. &amp; polymer science</td>
</tr>
<tr>
<td>L.H. Olson</td>
<td>PhD(Physics)</td>
<td>Assoc. Prof.</td>
<td>Textile Eng.</td>
<td>Fiber &amp; textile physics</td>
</tr>
<tr>
<td>C.G. Shea</td>
<td>PhD(Physics)</td>
<td>Assoc. Prof.</td>
<td>Physics</td>
<td>Optics</td>
</tr>
<tr>
<td>R.S. Phillips</td>
<td>BS(Chem)</td>
<td>Res. Ass.</td>
<td>Chemistry</td>
<td>Biochemistry</td>
</tr>
<tr>
<td>W.C. Tincher</td>
<td>PhD(Chem)</td>
<td>Assoc. Prof.</td>
<td>Textile Eng.</td>
<td>Textile &amp; polymer chemistry</td>
</tr>
<tr>
<td>R.M. Wartell</td>
<td>PhD(Physics)</td>
<td>Asst. Prof.</td>
<td>Physics</td>
<td>Biophysics</td>
</tr>
<tr>
<td>M.O. Watson</td>
<td>MS(CerE)</td>
<td>Pre-doctoral Fellow</td>
<td>Ceramic Eng.</td>
<td>Crystal growth, phase equilibria &amp; metallurgy</td>
</tr>
<tr>
<td>J.R. Williams</td>
<td>PhD(ME)</td>
<td>Assoc. Prof.</td>
<td>Mechanical Eng.</td>
<td>Energy conversion</td>
</tr>
</tbody>
</table>

1 Graduated with highest honors in chemistry in June, 1975; first in class.
2 Participant in Georgia Tech’s 1974 SSTP; early entrant at Tech in September, 1974; boys’ counselor in 1975 SSTP; dean’s list 1974-75.
3 Graduate student.
4 Senior in chemical engineering with working experience in plastics engineering.

We believe that all members of the academic community should work with SSTP participants; all have special advantages of experience and perspective credibility, empathy, ability to communicate, etc. which must be used. In our 1975 program, research advisers included people of most ages (from 17 to fifty plus), both sexes (too few females), three races, with principal degrees in seven fields and at least twenty different specialties. Seven (7) professors, six (6) associate professors, eight (8) assistant professors, four (4) professional staff members, one (1) postdoctoral fellow, four (4) predoctoral fellows, six (6) MS degree candidates, two (2) undergraduate students, and one
technician. We have found that involving senior faculty is necessary and beneficial to students and the program. If senior faculty care and participate, students in the SST program will return as undergraduates.

At least three of the students participants, are continuing to work on their research problems. Greg Hammett has been at Tech a few times since August to work with Professor Fink and his group in nuclear chemistry. David Tabby continues his work on membranes for reverse osmosis. Kim Harvey is working on flame retardants for her entry in the Westinghouse Science Talent Search.

B. Seminar & Demonstrations Program

Seminars and demonstrations were almost identical to those outlined in the proposal. The forty-four (44) seminars in science, engineering, and mathematics centered around polymer science and textile chemistry and engineering are listed along with seminar leaders and demonstrators in Appendix II. These seminars and demonstrations and participants reports on their research took up about seventy-five (75) hours. Attendance was required.

Seminar leaders and demonstrators were eight (8) of the nine (9) members of the faculty of the School of Textile Engineering. (Since August 1, 1975, three new faculty members have joined the school bringing the faculty to its full strength of twelve (12) members.) Seminar leaders were:

<table>
<thead>
<tr>
<th>Name</th>
<th>Degree</th>
<th>Position</th>
<th>Specialty</th>
</tr>
</thead>
<tbody>
<tr>
<td>W. C. Boteler</td>
<td>M.S. (M.E)</td>
<td>Professor</td>
<td>Mech. &amp; textile eng.</td>
</tr>
<tr>
<td>W. C. Carter</td>
<td>PhD (Chem)</td>
<td>Professor</td>
<td>Polymer &amp; textile chem.</td>
</tr>
<tr>
<td>W. D. Freeston</td>
<td>PhD (ME)</td>
<td>Professor &amp; Director</td>
<td>Mechanics &amp; mech. &amp; text. eng.</td>
</tr>
<tr>
<td>R. C. Latham</td>
<td>M.S. (Econ)</td>
<td>Assoc. Professor</td>
<td>Textile processes</td>
</tr>
<tr>
<td>J. L. Lundberg</td>
<td>PhD (Chem)</td>
<td>Callaway Professor</td>
<td>Polymer chem. &amp; phys.</td>
</tr>
<tr>
<td>L. H. Olson</td>
<td>PhD (Phys)</td>
<td>Assoc. Professor</td>
<td>Textile &amp; fiber phys.</td>
</tr>
<tr>
<td>A. Tayebi</td>
<td>ScD (M.E.)</td>
<td>Asst. Professor</td>
<td>Mechanics &amp; mech. &amp; text. eng.</td>
</tr>
<tr>
<td>W. C. Tincher</td>
<td>PhD (Chem.)</td>
<td>Assoc. Professor</td>
<td>Polymer &amp; text. chem.</td>
</tr>
</tbody>
</table>
Seminars were generally well received by participants. Students are programmed for fifty (50) minute classes; our longer (1½ hour) seminars were long for them at the beginning of the program. We favor 1½ hour seminars over shorter seminars because time lost in assembling students after breaks and because students will have 1½ hour classes as soon as they enter many colleges.

C. Colloquia

Participants responded well to eight (8) colloquia with speakers from outside the School of Textile Engineering. Five (5) speakers came from off campus; four (4) from other schools at Georgia Tech. About fourteen (14) hours were devoted to colloquia. Attendance was required.


6. "White House Fellows Program, Agriculture, Politics, Hunger, Energy Crunch, etc" - J.E. Bostic, Deputy Assistant Secretary, U.S. Department of Agriculture, Washington, D.C.


D. English Clinic

Professor James Bynum of GeorgiaTech's English Department led two short seminars on English. In these he explored with the participants our need for good command and use of written and spoken English and drew from them some of their feelings about their study of English. At the first seminar he asked each participant to write a short theme describing a recent experience with real meaning to him or her. Professor Bynum read and analyzed these themes writing on each his estimates of the writing, suggestions as to how each student could improve his or her writing, and some words of encouragement. Professor Bynum returned these at a second seminar with further discussion of written communication. Several of the members of the Georgia Tech faculty are convinced that English is the most important subject in all curricula at Georgia Tech. We continually encourage our students to improve their use of their language. We have extended this to our SST program.

E. Computing Seminars

Mrs. Cheryl Allen, Systems Analyst in the Office of Computer Services at Georgia Tech, arranged guided tours of computing facilities for each of the participants (taken in small groups). She conducted five (5) two hour sessions on computing, chiefly use of the Control Data Corporation Cyber '74 system, the Univac 1108, PDP 8 computers, and the Calcomp" plotter. Attendance at these computer seminars was voluntary. In addition, Mrs. Allen and other members of the Georgia Tech Computer Center's staff served as willing programming counselors to introduce our SSTP participants to computing. All students were provided with necessary account numbers, identification, etc. so that
they could use the computing facilities at Georgia Tech. About one third of the students did use the computers; a few became quite adept at computing and playing computer games.

Professor L. H. Olson introduced SSTP participants to the small computers in the School of Textile Engineering. Three (3) two hour sessions, with one third of the students at each, were sufficient. Interested students continued to work with the Hewlett-Packard computers, data logging, and plotting systems with the help of Professor Olson and Mr. Frank Ko and other graduate students.

F. Counseling

Dr. Barbara Winship and Dr. Tom Parker of the Student Counseling Center at Georgia Tech met with the students the first day of the program. A few days later the participants visited the Counseling Center. In this way, they became aware of some of the help available from these dedicated and able psychologists. In their seminar, Drs. Parker and Winship discussed the transition from home to college life the participants were experiencing and would face again in a little over a year, some of the ways to develop effective study habits, and how the participants might help themselves to enrich their experience in our SST program. Dr. Parker was particularly helpful in communicating with three of the minority group participants who were discouraged at the slowness of their research and a bit overwhelmed by Tech, the program, and meeting and competing with many different, able young people. Dr. Parker "saved" these students and "turned them on".

G. Special Seminars on Advanced Subjects

Thirteen special seminars on mechanics, thermodynamics, quantum mechanics, statistical thermodynamics, and spectroscopy were offered with attendance
From ten to fifteen students participated. Dates and subjects were:

2. "The First Postulate of Thermodynamics" - June 23, 1975
6. "Planck's Quantum Mechanics: S = k \ln W" - July 9, 1975
7. "Planck's Quantum Mechanics: \varepsilon = h\nu" - July 10, 1975

J. L. Lundberg was seminar leader. Participants were provided with detailed notes.

H. Field Trips & Visits

All participants visited the Fernbank Science Center where they enjoyed a special demonstration of the planetarium by Mr. Julius Staal, Planetarium Chairman, and demonstration of and observation using telescopes in the observatory led by Mr. John Burgess, Planetarium Lecturer. SSTP participants enjoyed the Center's nature walks and displays. The Georgia Tech SSTP participants met a few of the Fernbank SSTP students during the course of the afternoon.
Our SSTP students visited the nylon manufacturing plant of the American Enka Company at Central, South Carolina. Here they learned about and saw the polymerization of caprolactam to nylon 6; the purification of nylon 6; fiber spinning, drawing, and texturing; laboratory testing and fabric and carpet making, dyeing, and evaluation. On the same trip they visited the Duke Power Company’s Oconee Station, a nuclear-hydroelectric complex with three reactors and steam generators, two lakes at different levels, and water conduits and generator and pumping systems. We were on the power house floor when three mammoth generators were delivering about 2.6 \times 10^3 \text{ watts}. Here we gained some appreciation of how much energy we use and to what extremes we must go to satisfy our needs.

On the Georgia Tech campus, all students visited the Library, Computer Center, Engineering Experiment Station, Nuclear Reactor, Student Counseling Center, and the Schools of Chemistry, Physics, and Ceramic, Chemical, Electrical, and Textile Engineering.

I. Science Movies

Motion pictures on science and engineering were shown four nights weekly in the first three weeks of the program. Attendance was optional. A list of movies shown is given in Appendix III.

J. Recreational and Group Activities

SSTP participants enjoyed eleven (11) recreational and group activities in the 48 days from Sunday, June 15th, through Friday, August first. Average
intervals between activities was four days; the longest interval was eight days. Teen aged young people need and want both planned, group recreation and unstructured, unplanned activities. Campus recreation facilities and teen-age creativity combine to provide sufficient of the latter. Also a number of the students attended concerts of the Atlanta Symphony Orchestra whose home is close to Tech. Motion pictures are shown on campus Friday evenings during the summer; on Saturdays when no group activities were planned, participants were taken to theaters of their choice in Atlanta. Mr. A. J. Maguire, III, and the faculty tried to provide sufficient and varied recreational group activity; most students wanted more such activity. No funds provided by the Foundation can be or were used in any way to support recreational or group activities.

A listing of these activities is given in Appendix IV.

K. Communication

Communication gaps did exist in our program; we simply do not listen to one another. To maximize communication we used the following channels:

1. Weekly programs (schedules) were provided to each student. 2. Orientation and question and answer sessions were held by faculty members, Mr. A. J. Maguire, and student dormitory counselors, Miss Victoria Gordon and Mr. Kenneston Carr. 3. Meetings among SSTP participants, Georgia Tech students, faculty, staff, and participants in our past SST programs in the lobby of the Textile Engineering Building. 4. Visits by Mr. Maguire and faculty members to dormitories. 5. Faculty members and SSTP participants eating together at lunch and supper. 6. Faculty members keeping open the doors to their offices and visiting laboratories to talk to and help participants.
IV. Results of the Program: Evaluation

A. General

This 1975 SST program was our third, annual program at Georgia Tech. Participants from our first program who came to Tech are in their sophomore and junior years, and one is a senior. Those from the second program are freshmen and sophomores. We have observed closely the performance of these students at Tech; they have done well (GPA from 2.2 to 4.0 out of 4.0). Kenneston Carr has done excellent work in the laboratory in studying viscoelastic properties of elastin. Based upon their performance to date and upon past participants statements we believe that our 1973 & 1974 programs were successful and that our 1975 program will have served as well in developing science and engineering students.

B. Assessment of Research Results in the 1975 Program

The program director graded the research activity of each of the participants for this report. Grades are based on: 1. students' research reports, 2. estimates of performance by research advisers, 3. observations of and conversations with participants in the laboratories, and 4. general impressions by faculty members, other students' research advisers and the program director. Estimates of research performance compared to estimates of abilities of applicants (as given in Table II, page 7) are given in Table III. (The grade, "Good", with grade point 2.0 (C) is characteristic of abilities and work of students whom we would welcome to Georgia Tech as students of engineering, science or mathematics.)
<table>
<thead>
<tr>
<th>Estimated Potential as Applicants (No. of students)</th>
<th>Superior (A=4.0)</th>
<th>Excellent (B=3.0)</th>
<th>Good (C=2.0)</th>
<th>Fair (D=1.0)</th>
<th>Poor (F=0.0)</th>
<th>Average GPR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gifted (A=4.0)</td>
<td>2</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>4.0</td>
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<tr>
<td>Very Good (B=3.0)</td>
<td>5</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>0</td>
<td>2.8</td>
</tr>
<tr>
<td>Good (C=2.0)</td>
<td>19</td>
<td>1</td>
<td>8</td>
<td>9</td>
<td>1</td>
<td>2.5</td>
</tr>
<tr>
<td>Fair (D=1.0)</td>
<td>7</td>
<td>0</td>
<td>4</td>
<td>3</td>
<td>0</td>
<td>2.6</td>
</tr>
<tr>
<td>Poor (F=0.0)</td>
<td>4</td>
<td>1</td>
<td>0</td>
<td>3</td>
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<td>Total</td>
<td>37</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2.6</td>
</tr>
</tbody>
</table>

Average Estimated Potential: 1.83

Students whose potential was estimated to be from poor to good performed beyond expectations. No participants did poor work; one was only fair. Of the participants rated as good in performances, perhaps three to five of these were between fair and good; hence, these few were overrated a bit. No overestimates were made in "superior" and "excellent" ratings. These estimates of performance are made on the same basis we judge research performance of Georgia Tech undergraduates in special problems courses. Estimates of potential are the same as those for entering freshmen.

Comparison of estimates of ability and performance bears out the thesis that the necessary and almost sufficient condition for success is desire; ability as measured by tests, grades, class rank, etc. is secondary. This
certainly is the case for the students from the Atlanta city schools; based upon exam scores, only two, or at most, six, of these should consider entering any college.

In our 1975 SST program we estimated potential of students to be lower than in the 1974 program ($1.83$ versus $2.47$); we had fewer "gifted" or "very good" prospects. Never-the-less, faculty and staff concensus was that the 1975 group was better than the 1974 group. Our estimates of performance were $2.62$ in 1975 and $2.45$ in 1974. In 1975 fewer "gifted" but lazy students participated.

All of the participants in the 1975 SST program profitted from it. Almost all worked at least reasonably hard; none "goofed off" completely. In this respect, the 1975 group was better than their 1974 counterparts. All participants in our 1975 program can "make it" in college; all are good prospects. Most of the participants can do well in engineering or science.

C. Students' Evaluation of the Program

Again in 1975, students' evaluations of the Georgia Tech SSP program were more favorable than they should be. Questionnaires were late in being sent to students (because of personnel changes; Mr. A. J. Maguire, III, left for another position.) To date the fifteen (15) responses to the questionnaire in Appendix V (with numerical results) permit us to conclude:

1. Forty five (45) seminars is about the right number.

2. Students are programmed for 50 minute classes; 1½ hour seminars are long for them, at least at first.

3. Freshmen to junior level in college is about the right level for seminars.
4. Seminars of greatest interest to students ranged over a variety of subjects from color and dyes and fabric formation to quantum mechanics.

5. Fabrics of least interest included fancy weaves, dyeing, and chemistry. Similar subjects by the same seminar leaders appear in both most and least interesting categories; this may be due to the diversity of students in the program.

6. Most participants want more "outside" speakers, cost and logistics not withstanding.

7. Most students would welcome as much or more material in seminars.

8. We offer enough different research problems to satisfy almost all participants.

9. Faculty assistance in research was better than good; few found faculty less than helpful.

10. Two thirds of students found procuring materials and instruments to be easy; for one third this was hard.

11. The same or some more time should be devoted to research.

12. More time should be devoted to familiarizing participants with Tech's research and recreational facilities. Such help was available to all on individual or small group basis.

13. Students like organized outings; time, financial, resources, and stamina of faculty and staff limit these.

14. The trip to the fiber plant, the nuclear and hydroelectric facility, and Clemson University's beach was the favorite outing. Visiting Callaway Gardens in the rain was least favored.
15. Students have about the right amount of free time.
16. Research is a favored activity, at least in retrospect.
17. Most students liked our SST program as it was run in 1975.
18. We should continue to emphasize research.

D. Good Points of the Program

Research was our chief activity; the fun of research and satisfaction from accomplishment were the most cited "good things" in the program. Most participants got real results in their work. A few projects with particularly significant results are:

1. Vincent Bradford, "Creep of polypropylene and nylon 66 fibers".
2. Jennifer Buchanan, "Physical properties of spider silks".
3. Tommy Craft and Tony Kehoe, "Crack propagation in fabric chutes for escape from aircraft."
4. Bobby Dye, "Design and construction of prototypes of beds for patients suffering from severe burns".
5. Greg Hammett, "Analysis of nuclear structures of Pt$^{199}$ and Au$^{200}$ by gamma ray spectroscopy".
6. Kim Harvey, "Flame retardants for fabrics and carpets".
7. James Kee, "Effects of CO$_2$ concentration on plant growth".
8. Evanthea Parker, "Effects of solar radiation on bovine ligamentum nuchae."
9. Dawn Pollard, "Reactive dyes on cellulose: effects of dyeing conditions".
10. Paul Winchester, "Recycling paper".
Each year we can offer a greater diversity of research problems and find research advisers for a wider range of research suggested by participants. This is thanks to enthusiastic participation by colleagues in other schools and centers at Georgia Tech. With greater diversity of research problems, special seminars in advanced chemistry and physics, visiting colloquium speakers, and additions to variety of material presented in the seminar program, our program has become more diverse (interdisciplinary or multidisciplinary in current jargon). We find that students learn chemistry and physics at least as easily using macromolecular systems with reference state a partially ordered composite structure as using the usual small molecule compounds with the ideal gas and sodium chloride crystal as reference states.

Colloquia with outside speakers were well received. For the third year, Dr. James E. Bostic, Deputy Assistant Secretary of Agriculture, came to visit and lead a discussion in our SST program. Dr. Bostic is a favorite with the students; each year they quiz him for about two hours on a wide variety of subjects.

Dr. James Bynum's contributions in helping participants appreciate the importance of English and to write better were needed and appreciated. By the second week participants knew that English was and is their most important subject.

More students used the computers this year than in previous years. Game playing and plotting pictures, calendars, etc. decreased; useful computing increased. A few used computers in their research. Mrs. Cheryl Allen of the
Computer Center and Professor L. H. Olson of the School of Textile Engineering were more than effective in introducing participants to computing.

Special seminars on Newton's mechanics, thermodynamics, quantum mechanics and statistical thermodynamics were well received. From ten to fifteen students participated. High school students seem to understand Max Planck quite well; we used his 1901 paper as text material.

Nature knows no disciplines; she needs no interdisciplines. Introducing students to science, engineering and math in the manner is easy. Comments from past participants about this and the ease with which 1975 participants learned give credence to the thesis that teaching math, science and engineering together with many examples familiar to the students make easier the learning and give relevance to otherwise abstract ideas. Too often we forget that nature and students do not require and the latter do not appreciate dividing studies into disciplines; rather, these artificial divisions hamper learning.

Most students are sheltered to the extent that they haven't been in a factory, for example. Therefore, the visit to the nylon plant and the nuclear power station is a real "eye opener".

Miss Victoria Gordon, a 1973 SSTP participant early entrant at Tech in September 1973, senior majoring in textile chemistry, was the girls counselor. Her counterpart for the boys was Mr. Kenneston Carr, 1974 SSTP participant, early entrant in 1974, sophomore majoring in textile engineering. These fine, bright, scholarly and active young people contributed immeasurably to the 1975 program. For example Vickie Gordon was the editor of the Georgia Tech student newspaper during summer quarter of 1975. From her the SSTP participants learned
much about campus life, activities, the newspaper game, and how to "make it" at college, both academically and as a BWOC (big woman on campus). Kent Carr worked part-time on studies of the viscoelastic behavior of elastin during the academic year and the summer quarter of 1975. Students learned much from him in his research - patience, care, attention to detail, and the necessity of doing their best.

Students adjusted well to campus life. The program helped many to cope with being away from home and living on campus without the penalty of failure. A few of our participants probably would fail in college without this experience.

Including high school teachers in the program for 1975 was an excellent idea. We know now that to attract teachers they must receive credit toward degrees and/or certification or recertification for participating and they must receive generous stipends. The alternative is to use one or two day symposia during school hours and to provide substitute teachers for classes and for the local school administration to give credit for in-service training to teachers who participate. We shall try the latter this year.

E. Problems

Perhaps our most difficult task is to help SSTP students to develop some feeling for the nature of science and engineering and for the diversity of opportunities they will enjoy in college and after. Most students know only structured, discipline oriented, over-organized, and dogmatic secondary schools, which do not prepare them for college. Most SSTP participants have little feel for the experimental method and deductive reasoning, experimental technique, and little propensity to doubt, question, and test what they see.
read, and hear. Therefore, if participants are to have any meaningful experience in SSTP research problems, unjustifiably much faculty time is required for much one on one tutoring and help. We believe that we of the School of Textile Engineering and our colleagues in other Schools at Georgia Tech have made that committment of time. In spite of lesser "credentials", the 1975 participants were more able, inquiring, and productive than the 1974 group.

In 1975, we had no racial problems. SSTP participants developed good rapport and real affection for one another. One of the counselors is a minority member; more important, he is a kindly, level headed, friendly leader.

F. Changes in Future Programs

In future programs we shall continue to increase the diversity of research problems available. Further, we shall continue to encourage participants to suggest their own problems. Because of the diversity of ongoing research at Georgia Tech and the willingness of investigators to add research students to their groups or to branch out into new areas of investigation, we can find research advisors and facilities for most problems suggested by participants. Nine (9) participants suggested their own projects and worked on them in our 1975 program.

We had more projects in "go" condition in 1975 than in 1974. More participants found equipment and materials easier to obtain in 1975 than in 1974. We shall continue this improvement in 1976.

In 1976, we shall broaden our program making it even less reminiscent of traditional disciplines. The diversity and amount of material in seminars will be increased. We have emphasized that students need not worry about
deciding on major fields of study. The constant pressure from teachers, counselors, college admissions officers, and parents to elect majors bothers most students who really don't know what they want to study. Therefore, we have urged students to be undecided engineering or science majors and to take math, chemistry, and physics suitable for majors in each of these disciplines and the best English courses on campus. Further, we stress that as long as they take the "high road", choice of major is not as important as deans and registrars would have us believe. Taking the good courses suitable for majors in each discipline keeps options open. Further, we suggest that students group their elective courses and take what is in effect a second major. We try to orient our SSTP participants in this way and to ween them from their excessive cleaving to disciplines, curricula, etc.

G. Effects of the Program

The effect on participants was to increase in each an appreciation of science and engineering and an eagerness for real study at the university level. The SST program is excellent for recruiting good students to good schools. Seeing science and engineering first hand at Georgia Tech convinced a few undecided students that they must go to college. It has caused a few students with vague notions about studying some more esoteric subjects to consider science and engineering including polymer, fiber, and textile science and engineering.

Another effect of the program on some of the participants was to help them to "aim higher", at better colleges and universities in more difficult
curricula. This broadening of interests and horizons and the realization that they can "make it" in the better schools means that several of the thirty-seven (37) participants probably will register in science or engineering curricula in strong schools instead of beginning in less demanding curricula in lesser schools.

At least three of the students are continuing to work on their research problems.

Students in our 1975 program developed the real friendship for one another that was obvious in the 1973 group. The 1975 group enjoyed being together, enough that they will come to Georgia Tech on January 8-12, 1976, for a reunion. This regard for one another and communication among most students bridged differences in economic status, background, preparation, sex, and race. The participants learned more from each other than from faculty and staff.

The principal effect of the 1973, 1974, and 1975 programs on the School of Textile Engineering is that we started or pushed forward some research programs which would have languished without this spur. Of the problems worked on by students in 1975, at least twenty-eight are being continued; of these at least ten received major impetus from students working on the problem.

Another effect upon our school was to further acquaint us with and make us much more sensitive to hopes, needs, thinking, problems, strengths, and weaknesses of young people who are likely candidates for science and engineering. We learned how to reach several of these people through their schools, families, friends, etc. The School of Textile Engineering will continue to increase its
contacts with potential students of science by visiting more schools, giving more seminars and demonstrations in schools, helping more teachers and students with research projects and demonstrations, entertaining more visiting students and teachers at Georgia Tech, etc. In addition, we shall offer at least one workshop for teachers on research and experimentation in high school science.

H. Follow-up on the program

Follow-up on the program has begun. All participants in the 1975 program have received at least one letter from faculty and staff of the School of Textile Engineering. All have received a questionnaire requesting participants' reactions to the program; fifteen (15) participants have responded to date.

Georgia Tech faculty members have helped two of the participants to continue working on their research programs.

A demonstration kit showing polymerization of nylon, rubber, elasticity, drawing and texturing of fibers, fabric flammability, dyeing and finishing of fabrics will be distributed in January, 1976, to each of the high schools from which participants came. The student participants in SSTP will use these to demonstrate to fellow students some of what they have learned about polymers, fibers, and textiles.

The student participants, teachers who can come, and Georgia Tech staff and faculty will come to campus as guests of the faculty on January 8-11, 1976, for a reunion, recreation, and fellowship. At that time and in subsequent letters we shall learn the career plans of participants. We shall do our best to keep in touch with participants until they have graduated from colleges or become permanently employed after leaving school.
V. Suggested Improvements in the National Student Science Training Program

This program is excellent; it reaches young people at the right time to save a few for science in spite of the thrust of secondary education away from science and other difficult disciplines. Further, our SST program makes some students aware of the diversity of opportunities for study in science and engineering and that many paths lead to similar goals. Students have to know the existence of different curricula and study programs before they come to college if they are to consider enrolling in them.

The Foundation's staff knows better than we the two biggest improvements which can be made in the program. These are:

1) adequate funding for 200 plus individual programs,

2) announcing grants before September first of each year to give adequate time for publicizing programs and seeking additional funds for the following summer, and

3) enticing high school teachers to participate in the program.
Appendix I - Brochure
Appendix II - Seminars & Demonstrations

1. "Our World of Giant Molecules" - J. L. Lundberg
2. "Stress-Strain Behavior" - W. D. Freeston
4. "Near Equilibrium Kinetics" - J. L. Lundberg
5. "Viscoelasticity of Polymers" - J. L. Lundberg
6. "Molecular Size" - J. L. Lundberg
7. "Periodicity & Chemical Bonding" - W. C. Carter
8. "Chemical Bonding: Covalent & Ionic Bonds, Polarity, Acidity, etc." - W. C. Carter
10. "Vinyl Polymerization & Copolymerization" - W. C. Tincher
15. "Kinetics & Differential Calculus" - J. L. Lundberg
17. "Chemical Kinetics & Chain Reactions" - W. C. Carter
18. "Molecular Weights, Average Molecular Weights & Molecular Weight Distributions" - J. L. Lundberg
19. "Averages, Summations, Integration, Areas, Moments, etc." - J. L. Lundberg

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21. "Rubber Elasticity" - L. H. Olson
22. "Glassy Polymers" - J. L. Lundberg
23. "Wet Spinning of Fibers" - W. C. Carter
25. "Melt Spinning of Polymers with Emphasis on Nylons and Polyesters" - J. L. Lundberg
26. "Crystallization of Polymers: Primitive Unit Cells, Chainfolding, Extended Chain Crystals & Intercrystalline Links" - J. L. Lundberg
27. "Morphology & Structure of Polymers: The Composite Structure Model of Polymers - Spherulites, Row Structure, etc." - J. L. Lundberg
28. "Fiber Drawing & Texturing" - A. Tayebi
29. "Fiber Properties: Great Strengths of Fibers" - W. D. Freeston
31. "Dyes: How They Work, Light Scattering & Absorption" - J. L. Lundberg
32. "Dyeing: Kinds of Dyes, Application of Dyes, Screen Printing, etc." - W. C. Carter
34. "Flammability: Combustion & Ignition & Propagation of Flames and Chavs" - W. C. Tincher
36. "Yarn Formation: Old, Conventional & New Methods" - R. C. Lathem
37. "Fabric Formation by Weaving: From the Stone Age to 1975" - A. Tayebi
38. "Knitting: Plain & Fancy" - L. H. Olson
40. "Nonwoven Structures: Fabric Like Materials Made by Processes Other Than Knitting or Weaving" - W. D. Freeston
42. "Carpets: Ancient Asia to Dalton, Georgia" - W. C. Boteler

43. "Nature's Building Blocks, Fibrous Composite Structures: Collagen, Elastin, Bone, Cellulose, etc." - J. L. Lundberg

44. "Food, Fiber & Shelter: Some Estimates of Our Chances in Years to Come" - J. L. Lundberg

45. Research Reports by Students

46. Research Reports by Students

47. Research Reports by Students

48. Research Reports by Students

49. "Graduation: Presentation of Certificates of Participation and Mementoes" - Participants, parents, faculty, staff, and friends.

50. "Participants Remembrance Program: Skits, Slides, Gift Exchange, etc." - Participants, friends, parents, faculty and staff.
APPENDIX III - SCIENCE MOVIES

1. **UNIVERSE**: solar system, sun, etc.
2. **THE BEACH - A RIVER OF SAND**: Movement of sand along a shore.
3. **CAVITATION**: Forms of cavitation and effects in applications.
4. **CHANNEL FLOW OF A COMPRESSIBLE FLUID**.
5. **WHY MAN CREATES**: Nature of the creative process.
6. **CRYSTALS - AN INTRODUCTION**: Structures & properties of crystals.
7. **MEMORY DEVICES**: Various electrical storage devices.
8-12. **THE FLUID DYNAMICS OF DRAG**: PART I - SOME CURIOUS EXPERIMENTS. PART II - FUNDAMENTAL CONCEPTS. PART III - THE LAWS OF DRAG IN FLUID OF HIGH AND LOW VISCOSITY. PART IV - HOW TO REDUCE DRAG.
14. **AN APPROACH TO THE PREDICTION OF EARTHQUAKES**.
15. **BOUNDARY LAYER CONTROL**: Shaping, etc., to produce high life & low drag.
16. **RHEOLOGICAL BEHAVIOR OF FLUIDS**: Non-Newtonian flow & normal stresses.
17. **SURFACE TENSION IN FLUID MECHANICS**.
18. **TRANSITION FROM LAMINAR TO TURBULENT FLOW**.
19. **EVIDENCE FOR THE ICE AGE**: Landscapes and glaciers.
20. **THE FORCE OF GRAVITY**: Measurements and viewpoints of gravity.
21. **PRINCIPLES OF THE OPTICAL LASER**: How lasers work.
22. **MAGNETIC FORCE**: The earth's magnetic field.
23. **MAGNETOHYDRODYNAMICS**.
24. **PLAN FOR TOMORROW**: Use of natural resources in the Southeast.
25. **PHYSICAL CHEMISTRY OF POLYMERS**: Structures & properties of polymers.
27. **LOW REYNOLDS NUMBERS FLOWS**: Inertia-free, viscous flows.
28. **SIMILARITIES IN WAVE BEHAVIOR:** Mechanical waves, properties.

29. **THE SEARCH FOR NEW ENERGY I:** Bitumen, coal gasification, oil shale, recycled trash, offshore oil, magnetohydrodynamic generator, and geothermal sources.

30. **THE SEARCH FOR NEW ENERGY II:** Breeder reactor, nuclear fusion, solar energy systems, windmills, tidal energy converters, and atmospheric electricity as sources.

31. **PROBING PLANETARY PROCESSES:** Formation of the earth and moon.

32. **RESHAPING AQUATIC ENVIRONMENTS:** Regulating aquatic life systems.

33. **RADIO ASTRONOMERS PROBE THE UNIVERSE:** Radio waves from our sun, pulsars, quasars, and traces of organic compounds in space.

34. **AGRICULTURAL GENETICS IMPROVES YIELDS:** Plant genetics with emphasis on corn.

35. **SHARK-ANCIENT MYSTERY OF THE SEA:** Behavior of sharks.

36. **NORTHLANDS ENVIRONMENTAL IMPACT STUDY:** The Alaskan pipeline.

37. **ADVANCES IN BIO-MEDICAL ENGINEERING:** Replacement of bones and teeth, computer control of breathing, and artificial vision.
## Appendix IV  Group Activities

<table>
<thead>
<tr>
<th>No.</th>
<th>Date</th>
<th>Activity</th>
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<tbody>
<tr>
<td>1</td>
<td>Sunday, June 15</td>
<td>Open house &amp; &quot;Dutch treat&quot; supper with parents and friends</td>
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<td>2</td>
<td>Saturday, June 21</td>
<td>Visit High Museum of Art and Braves-Giant baseball game</td>
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<tr>
<td>3</td>
<td>Sunday, June 29</td>
<td>Open house and supper at Lundberg's home</td>
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<td>4</td>
<td>Friday, July 4</td>
<td>Outing &amp; fireworks display at Stone Mountain</td>
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<td>5</td>
<td>Saturday, July 5</td>
<td>Visit &quot;Underground Atlanta&quot;</td>
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<td>6</td>
<td>Sunday, July 12</td>
<td>Visit Six Flags Over Georgia</td>
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<tr>
<td>7</td>
<td>Sunday, July 20</td>
<td>Outing &amp; picnic at Lake Alatoona</td>
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<tr>
<td>8</td>
<td>Wednesday, July 23</td>
<td>Swim at Clemson University on Lake Hartwell &amp; supper at Coneross Fish Lodge</td>
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<tr>
<td>9</td>
<td>Sunday, July 27</td>
<td>Open house &amp; supper at Lundberg's home</td>
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<tr>
<td>10</td>
<td>Tuesday, July 29</td>
<td>Visit Callaway Gardens</td>
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<tr>
<td>11</td>
<td>Friday, August 1</td>
<td>Open house, &quot;graduation&quot; &amp; participants' program - reception for parents &amp; friends.</td>
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Appendix V - Students' Evaluation: Results
"Summer-75" (NSF-SSTP) Questionnaire

1. There were (too many 20%, too few 27%, right number 52%) seminars during the program.

2. Each seminar on the average was (too short 13%, too long 60%, right length 27%).

3. The ideal length for a seminar in the program would be (1 hr. 53%, 1 1/2 hrs. 33%, 2 hrs. 13%, 2 1/2 hrs., 3 hrs.)

4. Seminar material was (always, often 40%, seldom 53%, never 7%) at a level difficult for me to understand.

5. The seminars which interested me the had as their subject:
   a) Color & dyes (W.C. Tincher)
   b) Fabric formation: weaving (A. Tayebi)
      Flammability (W.C. Tincher). Quantum mechanics (J.L. Lundberg)

6. The seminars which were least interesting had as their subject:
   a) Fancy weaves (A. Tayebi). Knitting (L.H. Olson)

7. There were (too many, too few 87%, right number 13%) colloquia given by people outside the textile department's faculty.

8. There was (too much 13%, too little 47%, right amount 40%) material covered during the 7 week period.

9. There were (too many 33%, too few 55%, right number 12%) research topics from which to choose.

10. Faculty assistance on my research topic was (excellent 60%, good 13%, fair 13%, poor 13%).

11. Materials and instruments needed to carry out my research were (easy 67%, difficult 33%) to obtain.

12. (More 53%, Less 13%, right amount 33%) time should have been allotted for research.

13. (More 60%, Less 27%, right amount 13%) time should have been devoted to familiarizing me with Tech's research facilities.

Specifically: Library, computer research, School of Chemical Engineering, research in progress, campus layout.
14. (More 60%, Less 13% right amount 27%) time should have been devoted to familiarizing me with Tech's instructional, resource, research, and service facilities. Specifically: Entrance to Tech, library, research, service facilities.

15. (More 40%, Less 27% right time 33%) time should have been devoted to familiarizing me with Tech's recreational facilities. Specifically: Tennis, gymnasium, locations of facilities.

16. There were (too many, too few 73% right number 27%) organized outings.

17. The outing I most enjoyed was: Am. Enka - Duke Power - Clemson Univ. (60%); Six Flags Over Georgia (20%); Lake Alatoona (13%); Atlanta Symphony (7%).

18. The outing I least enjoyed was: Callaway Gardens (in the rain) 53%; Braves - Giants baseball game (27%); Lake Alatoona (7%).

19. I would like to have had (more 40%, less 40% right amount 20%) free time weeknights and weekends.

20. Had I had more free time I would have used it to 1. Do research (40%) 2. Read (20%). 3. Participate in athletics (13%).

21. I would recommend this program to my fellow students if:

   a) it were run much the same way (67%)
   b) a few changes were made (27%)
   c) the following major changes were made (7%)

1. More time is allotted for research 2. More activities are planned, particularly on weekends. 3. Two (2) one hour seminars, with breaks between seminars, are used. 4. Curfew hours are more strict. 5. More guidance is provided for students planning to enter Georgia Tech.

(Please tell us what you think and how you feel about our summer program) Your comments will help us in plans for "summer-76".

1. Students should select and study research problems before coming to the program. 2. Research should start the first week. 3. Research is the best part of the program. 4. A written paper on his or her research should be required of each participant. 5. Boys should have two (2) counsellors living with them. 6. Help to get participants into Georgia Tech activities (newspaper, bridge club, etc.) should be provided.