Engineering News

MESSIAH COLLEGE DEPARTMENT OF ENGINEERING • VOL. 6 No. 1 • October 2000

West Africa Pump Project Team Returns: Mission Accomplished!

Eleven Messiah College students and two advisors spent July and August, 2000, in Burkina Faso, West Africa, helping disabled people in the rural village of Mahadaga gain self-sufficiency and learn a marketable skill. The West Africa Pump Project (WAPP) is a project of Dokimoi Ergatai', an interdisciplinary service and learning initiative sponsored by the Engineering Department. Students from several disciplines began their work more than two years ago, seeking to serve God with the resources of their academic disciplines. Team members who traveled to Africa this summer included engineering, business, and communication majors. Dokimoi Ergatai enables Messiah College students, staff, and faculty to apply classroom learning to real-world problems. Our goal is to meet real needs today, while we are learning to be Kingdom builders for a lifetime.

In January 1998, a team went to Burkina to install solar-electric pumping and lights for a medical clinic. Following the project, Francoise Pedeau, Society for International Ministries (SIM) missionary and nurse practitioner, invited a team of Messiah College students to assist her ministry with the physically disabled. She asked us to help expand a small farming operation run by young adults into a self-sustaining agricultural micro-enterprise. Our team designed human-powered pumps to draw the water needed for irrigation. We also developed ways for persons with various physical disabilities

(continued on next page)

to operate the pumps. One of several arm motions may be used, each exercising different muscle groups, allowing the pumpers to do physical therapy as they water the garden. We also implemented solar pumping from a deep well to supply drinking water to a new school and work center for the physically disabled. By caring for the physical needs of others, we are sharing and receiving the love of Jesus. As we offer the resources of our disciplines in service, we free local Christians and missionaries to devote themselves to their gifts and calling. At the same time, Messiah students are preparing for lifelong Christian service and leadership.

Dale Johnson helps to install the solar pump.

John Paul Peterson '03 enjoys a ride on a donkey.

Our team developed and tested several positive displacement-type pumps for lifting water out of hand-dug wells. We designed a double piston pump that uses check valves to direct water intake and discharge. The check valves, pistons, and entire pump structure are made from PVC pipe and fittings. The valve flap is rubber, the piston cups are leather, and the drive rods are steel. We made our own check valves at a much lower cost than those commercially available. Many pump installations at village wells position the pump at ground level, which limits the depth from which water can be drawn to less than 20 feet. We elected to install our pumps at the bottom of the well and push the water up, rather than pulling it from the top. A second pump, which is a modified version of the Mennonite Central Committee's (MCC) rower pump, is also constructed entirely of locally available materials and can be readily constructed by local craftsmen. Like the piston pump, our version of the rower pump pushes water from the bottom of the well toward the pump discharge, instead of pulling it from the top.

We developed two actuation systems for our pumps. One, the bicycle actuator, uses gears to gain mechanical advantage; the other uses a lever. Workers provide energy to the bicycle system at low torque and moderate speed by turning a double crank. Two cranks on a common shaft are offset by 180°, like bicycle pedals. (In fact, the design is readily modified to permit actuation using leg power to create the required rotary motion.) They may be turned by one user using both hands or by two users, children for example, each turning one of the handles. User input is transmitted through a system of chains and gears to a second offset double crank that turns at lower speed and higher torque. Ropes, one on each side of the output crank, connect the actuator to the two pistons. As one rope is rising, the other is lowered. Force transmitted through the rope on the rising side lifts both the pump piston and several concrete counter weights resting on the piston rod. As the rope is lowered, the counterweights push the piston down, returning it to its original position. We installed two bicycle-piston pumping systems, one each at two different wells.

The rower pump is actuated by a lever. Persons with the use of their legs raise and lower the pumping mechanism on one side of the lever by pushing up and pulling down on a handle on the other side. Moving operators who are more powerful closer to the pivot provides a longer stroke

By caring for the physical needs of others, we are sharing and receiving the love of Jesus. As we offer the resources of our disciplines in service, we free local Christians and missionaries to devote themselves to their gifts and calling.

length and higher flow rates. Less muscular users may stand farther from the pivot and still readily operate the pump. A number of garden workers have lost significant use of their legs to polio. For these persons, we developed a system of ropes, pulleys, and counterweights that allow the user to sit on the ground or a bench and actuate the pump by a rowing motion. One adult or two children may grasp the input handle to operate the pump by this mechanism. We installed four lever-rower pumping systems, one each at four different wells.

Before our work this summer, workers carried water by hand from a single well at

(continued on next page)

the center of the property to water their crops. Crops were shoulder high this summer near the well, but diminished in height to 12 inches at a radius of about 40 feet from the well. This is the distance over which workers were able to carry adequate water to their crops. We now pump water into elevated 55-gallon drums for distribution throughout the property. Water flows by gravity from the drums into a network of 1" diameter PVC pipe that delivers water to 12 strategically located points of distribution. Whether our clients choose to continue watering crops by hand or use new drip irrigation methods that we introduced, we expect that the availability of water throughout the property will significantly increase the overall production of salable produce. Increased revenues will help this ministry to remain financially self-sustaining, independent of outside financial resources. Higher revenue may also create additional jobs for persons with disabilities.

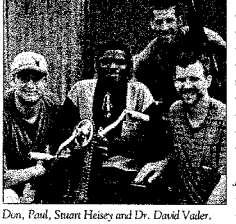
The team also installed a solar-electric powered pump in a deep well across the street from the farm. Clean water from this drilled well is suitable for drinking. Water pumped into a tower flows by gravity to a new learning and work center for the disabled. We also replaced an identical pump and controller installed by the 1998 Messiah College team for a nearby medical clinic. The old pump will be rebuilt and serve as a backup for both the clinic and center. The availability of drinking water enabled Francoise to officially open the learning and work center, a project of many years.

Rejoice with us as they experience a caring community and the love of Christ.

Disabled persons in Burkina Faso, one of the world's poorest countries, are among the most marginalized persons in the world. Please pray for this ministry of the Church that enables them to attend school and find employment, opportunities previously denied to them. Rejoice with us as they experience a caring community and the love of Christ. Please also pray for the spiritual growth of Messiah College students who are about to make important decisions about where and how they will invest their gifts and talents throughout their lives. Finally, please pray with us for Messiah's relationship and long-term commitment to the community where we are serving.

Journal Entries of Project Team Members

from Don Everett's journal



Don, Paul, Stuart Heisey and Dr. David Vader.

In Ouagadougou, I met a Burkinabe named Paul. Over the course of several days we shared many things and became good friends. Paul invited me to his house so that I could see where he was living. I could not believe how little he had: only two small rooms, one just big enough for his sleeping mat and a broken wooden chair, and the other one was about four foot square. He had no electricity and no running water. Paul offered me a drink from his water bucket, but when I looked the water was brown so I thought it best if I did not accept.

I had always heard about African poverty when I was in the United States; I had even seen it upon arriving in Africa. Now it was different. The person in poverty was not just someone over there; he was my friend Paul. The sad part is that Paul lives very well compared to others in his country. He has plenty of food and his health. Many Burkinabe cannot say the same.

Over the next couple of weeks, I developed a deep appreciation for the blessings that God has bestowed upon me. I also began to appreciate the fact that I attend a Christian college that is equipping me to help the people of the world who are in need. Messiah College and Dokimoi Engatai are putting knowledge to work and faith into practice through projects like the West Africa Pump Project. When we help those who are in need, we follow the example set by Jesus. We learn to be like Him.

from Mike Foster's journal

Many of us have a hard time really knowing that God protects us. By God's grace, I experienced His protection firsthand.

There is a 12' 4" tall water tower in the garden where we installed pumps and an irrigation system. A few days before our departure, we were filling the tower to check it for leaks. I climbed up to see how the water level was rising. Without a ladder, the only way to see into the tower top is to raise and lower oneself using four rebar "steps" that are anchored in the concrete walls of the tower. After sitting for awhile on top of the tank and checking the level with a tape measure, I began to climb down. My feet were on the second step from the top, about 3' down the tank wall, and I was holding on to the top of the tank wall. As I leaned back to move my hands down to the next step, a block of concrete at the top of the tower gave way under my grasp. I fell a distance of nine feet, striking the ground feet first just below my back. My back was arched as I fell, so I rolled backwards after hitting the ground and eventually struck my head. I was about ready to sit up when I started thinking, "Let's see how I am doing." Everything was working! The only real source of pain was a pebble that was poking into my back. In the end, I had a slight bruise on my tailbone and neck strain, which were both gone within a week and a half.

Matt and Julie Walsh with Mike in the back of a truck.

Summer Adventures in the Engineering Department

Faculty Member Designs Antenna for Spinning Spacecraft at NASA Goddard Space Flight Center

by Harold Underwood

Each year, faculty members from schools around the country apply for a limited number of summer fellowship appointments at NASA centers on a program administered by the American Society of Engineering Educators (ASEE). This year, a door of opportunity opened for Messiah College Engineering when I was selected for such an internship in the area of microwave antennas at NASA Langley Research Center and Goddard Space Flight Center (GSFC). With an eye toward a future working relationship between NASA and Messiah College Engineering, I accepted the offer at GSFC in Greenbelt, Md., where my family and I spent ten weeks this summer. Based on my experience, I can strongly recommend an internship with NASA as a stimulating and rewarding one for anyone interested in engineering and sciences.

I conducted my research this summer within the Antenna Group of the Microwave Systems Branch at GSFC. In collaboration with my new colleague(s) at GSFC, I explored the design of an electronically steerable phased array antenna to de-spin the beam of a spinning spacecraft (to keep track of the earth). While the idea of a spinning spacecraft is not new, two missions proposed as spinners within the next decade include the Magnetospheric Multiscale (MMS) http://sec.gsfc.nasa.gov/magmulti.htm and Inner Heliospheric Sentinels (IHS) http://sec.gsfc.nasa.gov/hws_sentinels.htm and others appear on the horizon.

As a first step, to develop a model, I learned a leading electromagnetics (EM) simulation software package (Ansoft Ensemble) for high frequency RF & wireless design. Ensemble simulates the 3D EM field of any 2D structure using a Method of Moments and a convenient Graphical User Interface (GUI) to draw layers of the planar structure. Ansoft also markets a related package (High Frequency System Simulator or HFSS) for full 3D structures using a Finite Element Method (FEM) of computation. However, for this project, as for the planar microstrip structures in general, Ensemble suffices. With the power of Ensemble, a Sun workstation, a few references and helpful suggestions from my colleague(s) at GSFC, in ten weeks of work I was able to find a design the meets all current specifications for the MMS mission. Each panel of the antenna (see Figure 1 below) consists of an X-band (8.0–8.5 GHz) linear array of dual-probe fed square microstrip patches including microstrip line feed network underneath (not shown in Figure 1). The complete design would also require phase shifters, switches, and power dividers that are not necessarily off-the-shelf components.

Incredibly, I have been able to bring back to Messiah College an unabridged version of Ensemble at an educational discount of less than 1/5 of its cost on the open market! I am enthusiastic about seeing students try and learn this software in ENGR 367 and beyond. Knowing Ensemble could easily be a ticket to entering the RF & wireless industry as a career. In addition, I welcome any questions about my project or experience on the NASA/ASEE SFFP @ GSFC including how you might become involved with me here at Messiah College or at Goddard. I expect to spend a second term of research on the same program during the summer of 2001. In the future, NASA University programs may be able to fund collaborative work between Messiah College Engineering and GSFC.

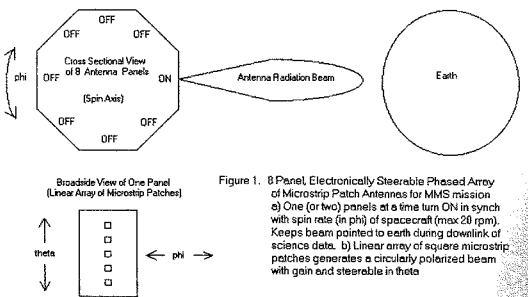
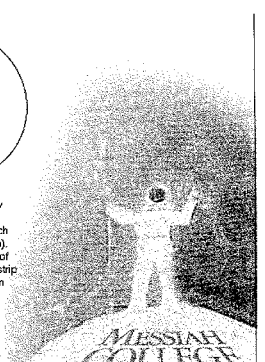


Figure 1. 8 Panel, Electronically Steerable Phased Array of Microstrip Patch Antennas for MMS mission
a) One (or two) panels at a time turn ON in synch with spin rate (in phi) of spacecraft (max 20 rpm). Keeps beam pointed to earth during downlink of science data. b) Linear array of square microstrip patches generates a circularly polarized beam with gain and steerable in theta



Award Recipients

James T. Scroggin Award

The annual James T. Scroggin Award for Excellence in Engineering was awarded to two deserving seniors for leadership and service in the Engineering Department and Messiah College as well as academic excellence. They were Bryan Ondrasik and Matthew Walsh. Congratulations, Bryan and Matt.

Dr. Dorothy J. Gish Women in Leadership Award

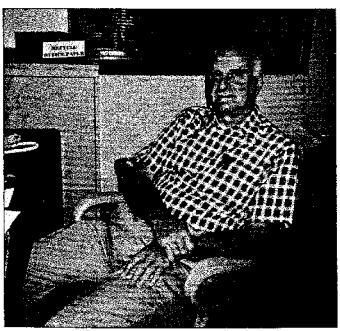
Julie Walsh, senior engineering student, has received a Dr. Dorothy J. Gish Women in Leadership award. The $500 award honors Dr. Dorothy Gish, retired faculty member and Dean of Messiah College. Julie received the award in part for her leadership of the West Africa Pump Project. She served for two years as team leader for the design of pumps. She was also part of an Advance Team that went to Burkina Faso in early July 2000 to prepare the project site for other team members. (Read more about the West Africa Pump Project elsewhere in this newsletter.) This year Julie is leader of a new project to develop human-powered personal transportation for the disabled persons in rural Burkina Faso, West Africa. She plans to use the $500 award to advance her ongoing service and leadership activities.

American Society of Mechanical Engineers Scholarship

The Susquehanna Section of the American Society of Mechanical Engineers (ASME) has awarded its annual $500 scholarship to Michael R. Foster, a junior in Engineering at Messiah College. In addition to his outstanding scholastic record, Mike is director of Dokimoi Engatai, a student organization that finds ways to use various academic disciplines for service. During the summer of 2000, he worked in West Africa on a pump project to assist local people with a low-cost irrigation system and to find a way to provide drinking water for a school. Mike also plays in Messiah's Wind Ensemble and takes photographs for the yearbook. Congratulations to Mike for this recognition of his accomplishments!

Instrument Society of America Award

Each year the Central Keystone Section of the Instrument Society of America (ISA) presents an Outstanding Student Award to a Messiah College student engineering team for their creative use of instrumentation and control systems. This year's winners, selected by the faculty, are Matthew Walsh and Dale Johnson for their design of a "Computerized Pump Testing System." Mr. Walsh and Mr. Johnson shared the cash prize of $500. Each has received a plaque and a one-year membership in the ISA. We are grateful to the ISA for encouraging outstanding work in the area of instrumentation and controls. Thanks to ISA member Mr. Dan Elliot of Distributed Systems Inc. for personally presenting the award at our 2000 Conference on Senior Engineering Design Projects in April.



Introducing our new Faculty member David Gray

David Gray is the newest member of the Engineering Department. He was born and raised in New Jersey. His wife of 33 years participates in prison ministries. His degrees are in electrical engineering: BSEE,'63, from Tufts University and MSEE, '65, and PhDEE,'69, from Stanford University.

His career in industry was all in the area of transmission, 30 years with Bell Laboratories followed by two years with Tyco Submarine Systems, Ltd., after AT&T sold its submarine division.

His interests include sports, reading, vegetable gardening, and interacting with young people. He has always loved sports: his current love is golf. His reading centers on worldview, philosophy, apologetics, and some history and culture.

Welcome David!

Notes from Our Alumni

Tony Carbaugh '98

Just wanted to let you know that I have become an electrical engineer for Snorkel. They offered me the position at the beginning of May, and I started working for them at the beginning of June. Working for Snorkel is great. My salary is double what I was making as a head soccer coach and they have a great relocation package. God really works and provides in amazing ways! I love the job so far!

Snorkel designs and manufactures aerial work platforms for rental companies and construction companies. We produce scissors lifts, articulating booms, and telescoping booms (everything from heights of 19 feet to 126 feet). I am working under a senior electrical engineer. We are the only electrical engineers on staff. We have a total of 30–35 engineers in the department. Our machines are driven by gas, diesel, and LP engines or by electric motors. One of the reasons I was hired is because the industry is changing and becoming more computer-driven. All of the machines use electrical control devices, joysticks, switches, sensors, etc., to operate them, so Snorkel needed another electrical engineer to help with design and to update electrical systems.

All the information I learned in college is coming back to me. Also, it's good that I have a solid mechanical background as well as electrical. I ended up two classes short of my ME concentration, but I plan on finishing that out . . . Snorkel will pay for my tuition. I am learning ProE (Pro Engineering) which is the CAD software program that we use. The program is amazing. We create everything in solid models (3D), models that are well over 300 megabytes of information, and there are tons of other useful components within the software package. I plan to start the process to become a Professional Engineer (PE). I think I will take the Fundamentals of Engineering (FE) exam sometime next year. Then I need to work as an engineer for another 3 years before I can take the final part of the test.

I am really excited about my position and this company. I like our engineering director and all the other engineers . . . they have made me feel comfortable. They are slowly working me in, so I am not overwhelmed. I want to thank you for the letters of recommendation. I am finally putting to use the great education that I received at Messiah . . . you just really have to trust in God and he will provide!

Wendell '96 and Teri Witter

Teri and I wanted to keep you all up to date on what God has been doing in our lives. I just finished my master's degree at Wheaton College in Educational Ministries with an emphasis on camp ministry. We just finished moving to a camp in northern PA called Three Springs Ministries. I will be serving as the director of intern and wilderness ministries for the camp and Teri will be right by my side. We are excited about how God led us to this place.

Wendell & Teri Witter
RR 1 Box 188
Morris, PA 16938
(570) 353-2102

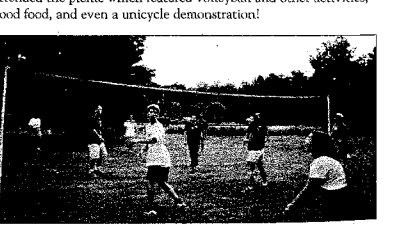
Congratulations to Seniors (Class of 2000) who graduated in May 2000

The Senior Celebration was held at the Gifford Pinchot State Park to honor the class of 2000. The BBQ spare ribs, grilled chicken breasts, salads, baked beans, watermelon, and brownies were very tasty. Volleyball, frisbee, and other activities involved the graduates, their families, and the engineering department faculty/staff. The seniors shared memories of their time at Messiah College and the great relationships they made with their peers and faculty. Congratulations to the class of 2000!

Stuart Heisey
Bryan Ondrasik
Eric Hammes
Peter Skinner
Abraham Wright
Andrew Peters
Matthew Brown
Matthew Walsh
Dale Johnson
Sam Berhanu
William Sorg
Brad Field
Joel Boone
Phil Shenenberger
Alex Hause

Welcome to Our New Engineering Students (Class of 2004)

The Erikson farm provided an opportunity for the new engineering students to get to meet the engineering faculty and their families, up close and personal. Over 40 students and faculty attended the picnic which featured volleyball and other activities, good food, and even a unicycle demonstration!



Engineering Program Re-Accredited by ABET

The Engineering Accreditation Commission (EAC) of the Accreditation Board for Engineering and Technology (ABET) evaluated Messiah's Bachelor of Science in Engineering (BSE) program during the 1999–2000 academic year. We are very pleased to report that ABET has granted continuing accreditation to our program. The BSE program was first accredited by ABET in 1994. With this renewal, we are among the first schools in the nation to seek and receive accreditation under ABET's new Criteria EC2000. The new criteria require implementation of quality assurance and continuous improvement processes for the program. Thanks to the many faculty, staff, students, alumni, and industry friends who took part in this important program evaluation.

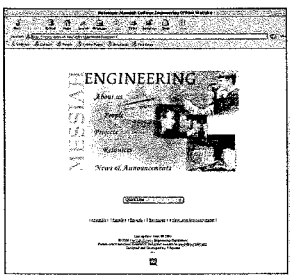
Criteria EC2000 includes the following 11 attributes:

1. an ability to apply knowledge of mathematics, science, and engineering
2. an ability to design and conduct experiments as well as to analyze and interpret data
3. an ability to design a system, component, or process to meet desired needs
4. an ability to function on multidisciplinary teams
5. an ability to identify, formulate, and solve engineering problems
6. an understanding of professional and ethical responsibility
7. an ability to communicate effectively
8. the broad education necessary to understand the impact of engineering solutions in a global/societal context
9. a recognition of the need for and an ability to engage in lifelong learning
10. a knowledge of contemporary issues
11. an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice

Addition of Computer Engineering Concentration

To meet the market demand of the 21st century, a Computer Engineering Concentration has been added to the existing Mechanical and Electrical Engineering Concentrations of Messiah's BSE program. This concentration combines the elements of electrical engineering and computer science to address issues of designing and using computers. Both hardware and software skills are required. Visit our web site www. messiah.edu/engr to see the curriculum guidelines for this new concentration.

New Engineering Web Page



You are invited to visit the new Engineering Department web page at www.messiah.edu/engr. Thanks to Visiting Professor Tom Nguyen for developing this new resource for students, alumni, and friends of Engineering at Messiah College.

Ferret House is Open for Business!

During the summer months Sarah MacPherson '01 and Joshua Kennedy '01 renovated an old turkey coop on the Erikson farm into a ferret house. Mina, a ferret, was bought and has begun her training as a landmine detector. Last Spring's newsletter highlighted Sarah's work in landmine abatement.

The mission of Messiah College is to educate men and women toward maturity of intellect, character, and Christian faith in preparation for lives of service, leadership, and reconciliation in church and society. Graduates of the Engineering Program will therefore be technically competent and broadly educated, prepared for interdisciplinary work in the global workplace. The character and conduct of Messiah Engineering graduates will be consistent with Christian faith commitments. We accomplish this mission through Engineering instruction and experiences, an education in the liberal arts tradition, and mentoring relationships with students.

MESSIAH COLLEGE
One College Avenue
Grantham, Pennsylvania 17027

Address Service Requested

3034

Mr. & Mrs. Harold R. Underwood
Campus Mail
Messiah College
PO Box 3034

Update on Other Collaboratory Initiatives

Genesis is going to the American Solar Challenge!

The Genesis Solar Racing Team has spent the last six years preparing for and competing in Sunrayce, a national collegiate solar race. This year we are proud to have the opportunity to be one of the competitors in the American Solar Challenge, a recently developed race which will be the longest in the world! The American Solar Challenge, which is open to companies as well as colleges and universities, will begin on July 15, 2001, in Chicago, Illinois, and will end nine days later in Palm Springs, California.

The new race is split up into four different classes of solar racing vehicles. Genesis will be entered into the open class, which allows us to use an improved version of our '99 car. With the new regulations, we are allowed to use more advanced technology for our solar array and a sophisticated lithium ion polymer battery pack, which will replace our current nickel metal hydride pack. We are also required by regulations to add a brake on the rear left wheel, which will improve our braking capabilities. We are also updating our current telemetry system so that the team and driver will be able to know more of what is happening within the car.

The format of the 2001 race will be very different from past Sunrayces. There will be one staged day where all teams will end together at the University of Missouri-Rolla. For the rest of the race, there will only be periodic media stops, and a typical race day will go from 8:00 a.m. until 5:30 p.m. Every night we will stop on the side of the road at the end of the day and set up camp there. In past races, the length of each race day has been determined by mileage, not time. The nights were usually spent at a pre-determined place, generally colleges and universities.

The team is eagerly looking forward to the opportunities that this world-class race brings. With a fresh, young team of approximately 20 members, Genesis hopes to improve our racing strategies by spending the school year testing our car near Messiah College.

For more information on the American Solar Challenge go to www.formulasun.org and click on the American Solar Challenge. To learn more about the solar racing team, please go to our web site at www.messiah.edu/genesis. We appreciate your continued prayers and support for this team as the new race year is beginning. Go Genesis!