

### TENNESSEE STATE UNIVERSITY RESEARCH HORIZONS







#### Tennessee State University

## **RESEARCH HORIZONS**

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### From the Vice President

Tennessee State University continues to contribute to the welfare of humankind through new discoveries from various research and scholarly activities, some of which are featured in this edition of Research Horizons. On behalf of the Division of Research and Sponsored Programs, I commend the remarkable efforts and outstanding contributions of our researchers, faculty, students and staff. The university continues to seek and exploit interdisciplinary, collaborative relationships with corporate, academic and government partners in areas that are vitally important to the local, national and global community. Collaboration is critically important in continuing our success in research areas that represent our strengths as well as developing new research initiatives that will grow the research enterprise at TSU. We continue to leverage our expertise and research programs in engineering, environmental and life sciences, agricultural science, health, education, and others to move into new and exciting areas.

As the premier public research university in middle Tennessee, TSU is committed to recruiting and retaining outstanding faculty, researchers, and scholars, and providing an environment where they can be successful and flourish. Construction of the new Research and Sponsored Programs building is underway and promises to provide much needed core laboratory facilities and additional space for new discoveries. Several other important programs and initiatives were not highlighted in this edition, such as the collaboration with Desert Research Institute, research in early childhood learning and teacher education, and multiple efforts in response to the Katrina disaster.

We continue to involve our students in research and other scholarly activities so that they might develop the necessary skills to make significant contributions in their respective fields. At Tennessee State, we believe research and scholarly activity is essential to excellence in education and enhances the learning experience of our students. The research enterprise at TSU continues to be vibrant, and coupled with our excellent academic programs, continues to provide exceptional opportunities for our students, faculty and researchers to make new discoveries and explore new horizons. Please enjoy this edition of Research Horizons.

As always, I remain

Sincerely, rous W. Shute

Marcus W. Shute, P.E., Ph.D. Vice President, Research and Sponsored Programs Tennessee State University



### From the Director



As the only public university in Tennessee's capital, it is important that Tennessee State University be an active participant in the state's and nation's research agenda. As a land-grant institution in an urban setting, we are positioned to address research questions and explore issues from a distinct and unique perspective. In the Division of Research and Sponsored Programs (RSP), we are committed to enhancing the research culture on campus to encourage and support our faculty and staff as they engage in research.

Fortunately, we have dedicated and capable researchers who have worked tirelessly through the years and whose efforts have had a positive impact on the university's research profile. The RSP staff is dedicated to matching the efforts of our researchers to provide them with the best possible research infrastructure to help them achieve their goals. In RSP, we take our jobs very seriously and we are determined to make progress regardless of challenges we may face. We understand that it is important to take time to recognize and celebrate achievements. This report recognizes the accomplishments of our esteemed faculty without whom our services would not be necessary.

It is a privilege to serve the TSU family and we look forward to a productive FY 2007. We stand ready to help our researchers, our collaborators, and friends of the university. We are truly here to serve.

Sincerely,

Maria Thompson, Ph.D. Director, Research and Sponsored Programs Tennessee State University

## Plants Enhance Degradation of Soil Pollutants

"Phytoremediation is the use of plant systems to clean contaminants from soil. Some plants can detoxify certain organic chemicals in their shoots, or mediate transformation through exudates released into their root zones (rhizospheres)." Dr. Kudjo Dzantor enthusiastically speaks of one of his favorite topics.

The Institute for Agricultural and Environmental Research at TSU executes its plan of work based primarily on the National Research, Extension, and Education goals of the U.S. Department of Agriculture along with input from internal and external stakeholders. These broad goals are to have a globally competitive agricultural system; a safe system; a healthier, well nourished population; greater harmony between agriculture and



the environment; and enhanced economic opportunities and quality of life for Americans. These goals are pursued through organization of their efforts into five teams as well as

collaborative projects with the University of Tennessee at Knoxville. One of these teams is the Environmental Protection and Enhancement Research Team, which is led by Kudjo Dzantor. The team's overall goal is to address issues of environmental pollution and degradation through research and development and implementation of sound and cost-effective practices, and to disseminate information about the environment to society at large.

Clean and safe environments are important to the economies of our nation as well as to other countries of the world. Unfortunately, these attributes have come under assault due to large uses of synthetic chemicals to enhance agricultural production for an ever growing world, and to maintain or improve standards of living of increasingly affluent societies. Threats posed to human and ecosystem health by intrusions of chemicals into the environment call for studies on behaviors of chemicals in soil, potentials for or



realities of their movement into bodies of water, remediation and mitigation strategies for existing or future contaminations, and best management practices that reduce dependence on manmade chemicals, or mitigate their environmental impacts. Integrating and implementing these studies and developments will lead to improvement in environment quality, protection of water resources, and overall environmental sustainability. The team's research goal has been established in several priority areas, one of which is naturally based strategies for remediating and mitigating environmental contamination and degradation.



Research Associate Deborah Long

Dr. Dzantor is researching the clean-up of soil and water by exploiting natural processes. Traditionally, societies would dump contaminants into landfills; then move the solid waste from one place to another. When the landfills fail, the pollutants leach into the surface or groundwater which is not only hazardous to the ecosystem, but also contaminates drinking water sources. Since the 1980s, scientists like Kudjo Dzantor have been investigating natural processes to clean up the soil. Initially, attention was focused on microbes; in the 1990s, the focus broadened to plant systems that can



Student Researcher Pauline Kamenyi

mediate the breakdown of organic contaminants. Rhizospheres possess a tremendous amount of microbial activity because of the plant exudates released in that zone. This enhanced activity can accelerate breakdown of some organic contaminants.

Dr. Dzantor is looking for plant-microbe associations that cause such accelerated degradation of contaminants. Some plant systems work better than others, and his lab is investigating the differences and why they occur. Scientists working in this area know that this variability relates to differences in types and amounts of root exudates released by different plants and, consequently, the size and composition of the microbial community associated with the plant. However, linking specific exudates and specific microbial participants with accelerated breakdown of contaminants is complicated. Fortunately, advanced molecular and analytical techniques are affording us greater

understanding of the environmental components and processes which can lead to our ability to manipulate them (rhizosphere engineering).

The focus of Dr. Dzantor's work is pesticides, but the principles apply to other organic contaminants such as industrial and munitions wastes. He is currently investigating the pesticides that predominantly are being used or tested for use in the nursery industry (one of Tennessee's most prominent industries). The goal is to elucidate plant systems that can cause the rapid detoxification of contaminants so that they can be used to buffer the land between the contaminated site and the water source. thus using plant systems to protect water quality. Dr. Dzantor says some environmental scientists refer to plants as



#### Dr. Kudjo Dzantor

green livers since the absorption and metabolism of contaminants by the plant shoots is similar to the detoxification of materials by the mammalian liver.



# Issues That Impact Education of Children with Communicative Disorders



In 1997, the Individuals with Disabilities Education Act (IDEA) was amended to strengthen academic expectations and accountability for children with disabilities.



The law stipulates that all preschool and school age children with disabilities receive services by professionals whose credentials meet each state's highest standard. Tina Smith,

Ph.D., Associate Professor in the Department of Speech Pathology and Audiology, is working to help the state of Tennessee to comply with this mandate by addressing the shortage of qualified speech-language pathologists (SLP) in Tennessee school systems available to teach students with communicative disorders.

In the state of Tennessee, the Board of Communication Disorders and Sciences requires all practicing SLPs to hold a master's degree as the minimal academic credential for licensure. Additionally, teachers must hold a valid Tennessee teacher's license with an endorsement within their work assignment. According to Dr. Smith, ensuring that all children who qualify receive services from master's level SLPs is problematic for three reasons: 1) there is a shortage of personnel to fill SLP positions in public schools, particularly in rural areas of Tennessee, 2) a large number of public school SLPs still do not hold master's degrees and need to upgrade their credentials, and 3) standards of accrediting bodies, such as the Council on Academic Accreditation and the American Speech-Language Hearing Association, place limitations on the number of

students Tennessee's accredited graduate programs in speech pathology are allowed to train in each class, thus impacting the state's ability to graduate adequate numbers of new SLPs as well as provide graduate training for practicing SLPs who hold bachelor's degrees.

Dr. Smith is the director for a state of Tennessee funded project designed to address the shortage of SLPs who hold a master's degree. First, her project seeks to recruit quality, minority bachelor level students into Tennessee State University's master's program in Speech Pathology and Audiology. Additionally, the project expands the scope of training to enable graduates to better serve children and adolescents with a variety of disabilities in the public school settings who are

culturally and linguistically different. Also, Dr. Smith is working to develop an effective system of retaining students who are pursuing a graduate degree in speechlanguage pathology. Ultimately, Smith seeks to establish a master's degree program in speech-language pathology via distance education. Offering graduate training via



distance education will not only provide a graduate education to practicing SLPs who desire professional development but will provide mandatory training in rural areas where SLP shortages are greatest.



# Research in Health Disparities at TSU



Dr. Calvin Atchison, left, Dr. Pamela Hull, center and Dustin Brown, right

Multiple units at TSU conduct research in health disparities. The Center for Health Research is funded solely by extramural support and focuses on statistical evaluations of a variety of health information giving meaning to an abundance of data. One of the recent projects in the School of Nursing studies the incidence and treatment regimens of diabetes. Also, faculty members from the Department of Sociology also study health disparities, and a current example is treatment of heart attack victims. Here are highlights of three current research projects:

Dr. Pamela Hull, Center for Health Research, received a Department of Defense grant to identify psychosocial and cultural barriers to prostate cancer screening among African American and white men. Results of the study can be used to design interventions aimed at increasing prostate cancer screening among African American men and reducing racial disparities in prostate cancer outcomes. Specifically, the current study proposes to explore the psychosocial and cultural beliefs held by African American and white men that act as barriers and/or facilitators to prostate cancer screening in detail through focus groups. Another objective is to develop a questionnaire that expands on the Health Belief Model (HBM) to encompass these psychosocial and cultural factors and to administer this instrument in a random sample of white and African American men in Nashville. This will allow comparisons of the instrument responses between African American and white men in order to identify which factors are

culturally derived. From this, recommendations for culturally relevant prostate cancer screening interventions for African American men and for men in general can be made.

Dr. Verla Vaughan in the School of Nursing has been focusing on collateral effects of diabetes. Chronic conditions such as diabetes are associated with elevated levels of depression. Co-morbid depression in diabetes is of concern because it may lead to poorer outcomes such as an increased risk of complications by lowering adherence to glucose monitoring, exercise, diet, and medication regimens (Ciechanowski, Katon, & Russo, 2002). African Americans are disproportionately affected with diabetes, but the relationship between diabetes, depression, and health outcomes among African Americans has been under-examined. A pilot study was conducted using an experimental design to evaluate the impact of depression on a diabetes intervention aimed at improving diabetes self-care and blood glucose levels among elderly African Americans living in publicly subsidized senior apartments. Findings from this project will be used to develop effective diabetes selfmanagement interventions in order to assist in decreasing diabetes related complications and death.

Dr. Barbara Kilbourne, Department of Sociology, spent this summer statistically analyzing the diffusion of treatment of myocardial infarction (MI) of elderly Tennesseans. This study, funded by the Agency for Healthcare Research and Quality (AHRQ), looks at the differences in treatment in urban and rural centers as well as treatment disparities received by advantaged and disadvantaged Tennesseans. Dr. Gottlieb Friesonger,



Dr. Verla Vaughan

retired Chair of Cardiology at Vanderbilt University, is her collaborator. The state-ofthe-art treatments for MI are angioplasty (PCA) and coronary artery bypass graft (CABG). Literature suggests that these procedures are done too often on those who have "good" insurance (supplemental insurance in addition to Medicare), and not often enough on those who do not have supplemental insurance. The probability of receiving a PCA is highest in those communities with the highest income levels, and much lower in rural communities. The location of the hospital or center also enters into this equation, resulting in apparent race disparity. The unadjusted odds of getting invasive therapies (PCA or CABG) are lower for African Americans. This is not totally based on race, but on the referral networks that African Americans tend to use. These referral networks tend to put African

Americans in hospitals with a lower likelihood of receiving invasive therapies. In Metropolitan Nashville, Whites tend to be referred to Saint Thomas Hospital, which has a higher rate of performing invasive

therapies, and Blacks to Baptist Hospital, which has a lower rate. A Black individual who is referred to Saint Thomas Hospital has the same unadjusted odds for receiving invasive therapy as a White individual; while a White referred to Baptist Hospital has the same unadjusted odds as a Black for not receiving invasive therapy. This comparable pattern can be seen in all metropolitan areas of Tennessee, where there is not a large enough diverse population to draw conclusions.



Dr. Barbara Kilbourne



## TSU Conducts Environmental Restoration Studies

Tennessee State University has a robust Environmental Engineering research program. Over the years, the research program has been enhanced through partnering with various government agencies. The program has a unique linkage to the U.S. Geological Survey (USGS) and the U.S. Army Corps of Engineers (USACE). Experts in microbiology, hydrogeology, toxicology and environmental chemistry from USGS and TSU's Civil and Environmental Engineering faculty are working together on cutting edge research projects. The expertise and application capabilities of the research program have also resulted in grants and contracts for TSU with the USACE and the



Water Environmental Research Foundation.

TSU, in partnership with the USGS, has been tasked by the USACE to assist remediating jet fuel

spills at Ft. Campbell Army Airfield, Kentucky. Over one million gallons of jet fuel are believed to have leaked from underground pipes at the site since the 1940s. Ft. Campbell is located on a karst terrain (limestone bedrock with conduits. caves and sinkholes), which makes groundwater remediation very difficult. The USACE specifically asked TSU and USGS to investigate and assess Monitored Natural Attenuation as a remedial option for mitigating the impact of the spills on human health and the environment. Research currently underway at Tennessee State University focuses on two primary issues regarding biodegradation in karst aquifers: (1) Does significant biodegradation of contaminants occur in systems with biological activity, geochemistry and flow characteristics found



Koushik Chakraborti, Lytreese Hampton and Zebra Jefferson collect clean groundwater from a deep bedrock well in Fort Campbell, KY to conduct lab tests.

in karst aquifers? And (2) if significant biodegradation of contaminants is demonstrated in bench-scale studies, how can these results be generalized to model actual karst systems?

Dr. Roger Painter is a Professor in the Department of Civil and Environmental Engineering at Tennessee State University. He is a professional engineer with twenty years of industrial experience as a Chemical/Environmental Engineer. His experience includes:

- Modeling of fate and transport of contaminants in groundwater, surface water, and the atmosphere.
- Design, modeling and simulation of chemical/environmental unit operations, and bioremediation systems.
- Expert knowledge of CERCLA and RCRA especially in the application of innovative technologies to environmental remediation.

In environmental engineering practice, ethical concerns are intrinsically tied to social and political environmental justice issues. Consequently, Dr. Painter also has expertise and interest in engineering ethics especially in the context of the broader aspects of environmental justice issues. He has taken an activist role at several environmentally-impacted sites where government and policy makers were challenged to interpret environmental codes and regulations in a fashion that was protective of human health and the environment. Dr. Painter uses his experiences as case studies in his environmental engineering design courses.

Dr. Tom Byl, an employee with the USGS as well as a faculty member at TSU, teaches graduate courses in applied microbiology and environmental chemistry and supervises the research efforts of undergraduate and



graduate students. Dr. Byl's background includes biology, plant biochemistry, and environmental toxicology and chemistry. After a postdoctoral fellowship at Clemson University, he has been a research grade employee with the USGS since 1994. His LEFT: LeMiracle Hendking is setting up an experiment to determine the optimum pH and supplement concentration for anaerobic biodegradation of trichloroethylene by indigenous karst bacteria

**RIGHT: Graduate Student Tarra Beach** 

duties in the TSU/USGS collaborative include research on surface and groundwater quality and the fate of chemicals and pathogens in the environment, in addition to teaching and advising students. This collaborative research program is multidisciplinary and draws students from civil engineering, biology, chemistry, computer science, math, and physics programs. The undergraduate and graduate students Dr. Byl has trained have made over 140 regional and national presentations in the past seven years. Additionally, his students have won more than 40 student awards for their presentations at the various national and regional conferences.









Farida Farouzon is preparing to collect a rare biolumenscent midge that lives in Pickett State Park, TN. Special permits were required to collect this organism for research.



Lashun King and Ahlam Ary prepare over a 150 microcosms for a long-term biodegradation study on the role of lactate and vitamins on TCE biodegradation by groundwater bacteria.

# Human Movement

Computer Aided Designs (CAD) and virtual reality platforms allow plans and predictions to be examined at much lower expense and risk than actual, physical testing of situations. These model systems require the input of multidisciplinary teams, with aspects of engineering, design, and human factors.

One type of situation benefiting from modeling is that involving human movement; one in particular is the design the living quarters for astronauts. Systems engineers model human motion for applications such as robotics and psychology. NASA's Marshall Space Flight Center (MSFC) in Huntsville has been working on methods to track human motion to analyze the feasibility of various



projects being designed. Human motion tracking systems capture human motion for replication in virtual environments. MSFC has been working to make the motion tracking systems more

reliable for testing and visualization situations in their Collaborative Engineering Center (CEC). For two summers, TSU's Tamara Rogers participated in the research to optimize the virtual reality system for human motion tracking. The most valuable outcome of this system will be the ability to

# **Researcher Uses** Virtual Reality To Simulate



incorporate human testing and verification of design alternatives much earlier in the process of design.

The Human Motion Tracking System (HMTS) was developed by previous faculty fellow Steven Henderson. The system incorporates sensors, called birds, which are placed on the user's head, waist, elbows, knees, hands, and feet to track the motion of the user and incorporates the motion in a CAD environment for a virtual reality experience

that allows the user to interact with objects under design. The initial work of Dr. Rogers showed the tracking system to be viable for interfacing with a given CAD environment, allowing a suited user to interact with a physical mockup, while the animated human figure mirrored those motions. Her recent specific activities were to: 1) enhance the overall reliability of the sensor position readings, especially at the feet; 2) incorporate the haptic feedback capabilities of the

CyberTouch™ glove; and 3) allow the user to manipulate the

other objects in the virtual environment.

Dr. Rogers has used this opportunity to introduce three undergraduates to human factors research at NASA, via projects, site visits, and even a summer position for one of the students. Her additional research activities build on her experience in the field of human-robot interaction and include the development of an Intelligent Personal Assistant Robot project. This project focuses on the aspects of human-robot interaction that will allow a robot to respond to, and even anticipate, the needs of people. This project will need to incorporate the robot's abilities to detect people and objects in the environment, to identify people, and to communicate by recognizing as well as generating speech. The current focus of the work is the development of the robot's decision-making capabilities. Dr. Rogers is sharing her experience in the field of robotics in TSU's Robotics and Intelligent Systems Laboratory, where, in addition to conducting robotics research, she hosts the weekly Robotics Club meeting.



**Dr. Tamara Rogers** 

### Tennessee State University Astronomer Participates in Historic Pluto Verdict

Frank Fekel is an observational astronomer at TSU who currently uses telescopes at the Kitt Peak National Observatory in Arizona as well as Tennessee State University's 2-meter Automatic Spectroscopic Telescope at Fairborn Observatory in Arizona. He obtains the spectra of stars from which he determines their basic properties such as their mass, size, rotation, brightness, distance, chemical makeup, age, and evolutionary state. He is particularly interested in binary stars similar to our sun.

Last summer, Fekel traveled to Prague to attend the International Astronomical

Union (IAU) General Assembly and participated in the historic vote to downgrade Pluto to "dwarf planet" status. A veteran of IAU meetings, Fekel voted in support of the new definition of a planet which led to Pluto's reclassification. He states that astronomers at the conference were somewhat divided on the matter and he expects the issue will be revisited.

Fekel is currently working on two large projects with TSU astronomer Greg Henry. One project involves a search for pulsating stars in the gamma Doradus class of variable stars. While Henry identifies the stars as having variable light output, Fekel determines if the star is a binary or single star and other basic properties so that various stars in the class can be compared with one another. In a second joint project, Fekel provides much of the basic data mentioned previously for about 300 solar-type stars that Henry is observing to detect spot cycles like those found on our sun.

The mass of a star can only be directly determined if the star is part of a binary. Fekel is collaborating with astronomers at the University of Texas and Mt. Wilson Observatory to obtain masses of stars in about 50 systems and to determine their distances and

brightnesses. Such information can then be compared with theoretical models to see whether the models need to be improved.

Dester of Proceedings

With astronomers at Kitt Peak National Observatory, Fekel began a project to determine the orbits of symbiotic binaries. Such systems usually consist of a very cool and large giant star plus a white dwarf companion. Observations were obtained at Mt. Stromlo in Australia until several years ago when that observatory was destroyed by a forest fire.

One of these symbiotic systems is extremely exotic, consisting of a cool giant star and a neutron star. Mass transferred from the giant to the neutron star results in extensive X-ray emission. The results of Fekel and collaborators showed that the orbital period of this system is about 100 times longer than any other known X-ray binary. Because its orbit is so different from other X-ray binaries, the components of this symbiotic binary must have a very unusual evolutionary history.



### Annual Report for Fiscal Year 2006

### SUBMISSIONS

### by Center/College/School

Academic Affairs	\$ 1,849,630
Agriculture and Consumer Sciences	1,687,201
Arts and Sciences	8,667,494
Business	491,942
Cooperative Extension Program	2,488,546
Center for Health Research	2,150,062
Center of Excellence - ISEM	1,458,925
Center of Excellence - RPC	3,251,649
Education	513,992
Engineering, Technology, and Computer Science	6,185,976
Health Sciences	982,361
Institute of Agricultural and Environmental Research	h <b>8,392,719</b>
Massie Chair of Excellence in Environmental Enginee	ring <b>418,156</b>
Nursing	320,070
RIMI Center for Neuroscience	3,431,498
Student Affairs	2,432,833
Research and Sponsored Programs	18,078,694
Total \$	62,801,748

### SUBMISSIONS

#### by Agency/Corporations/Foundations

Corporations \$	5 120,250		
Foundations	3,198,036		
Environmental Protection Agency	189,122		
National Aeronautics and Space Administration	1,881,308		
National Science Foundation	6,094,935		
Tennessee State Agencies	1,562,791		
U.S. Air Force Research Lab	861,162		
Office of Naval Research	122,500		
U.S. Army	430,684		
U.S. Department of Agriculture	14,402,845		
U.S. Department of Defense	7,499,663		
U.S. Department of Education	1,763,679		
U.S. Department of Energy	3,851,405		
U.S. Department of Health and Human Services/NIH	13,493,738		
U.S. Department of Homeland Security	450,000		
U.S. Department of Housing and Urban Development	4,650,000		
U.S. Department of the Interior	700,000		
Corporation for National and Community Service	1,499,630		
National Endowment for the Humanities	30,000		
Total \$ 62,801,748			



#### AWARDS

### by Center/College/School

Academic Affairs \$		1,049,976
Agriculture and Consumer Sciences		295,821
Arts and Sciences		2,246,640
Business		486,068
Center of Excellence - ISEM		2,323,951
Center of Excellence - RPC		4,666,382
Center for Health Research		362,651
Cooperative Extension Program		2,610,123
Education		508,000
Engineering, Technology, and Computer Science		2,553,751
Health Sciences		1,520,534
Institute of Agricultural and Environmental Resear	ch	4,031,165
Massie Chair of Excellence in Environmental Engin	eering	1,235,621
Nursing		175,220
Office of the President		20,000
RIMI Center for Neuroscience		861,405
Student Affairs		647,181
Title III		6,793,142
Total	5 32,	387,631

#### AWARDS

#### by Agency/Corporations/Foundations

Corporations	\$ 30,209	
Foundations	198,475	
National Aeronautics and Space Administration	1,901,720	
National Science Foundation	2,803,513	
National Geospatial-Intelligence Agency	750,000	
Tennessee State Agencies	313,864	
Tennessee Valley Authority	38,725	
U.S. Agency for International Development	23,778	
U.S. Air Force	65,000	
U.S. Department of Agriculture	6,575,380	
U.S. Department of Commerce	167,359	
U.S. Department of Defense	834,065	
U.S. Department of Education	9,019,399	
U.S. Department of Energy	530,000	
U.S. Department of Health and Human Services	7,942,638	
U.S. Department of Housing and Urban Developr	ment <b>1,030,000</b>	
U.S. Department of Labor	25,000	
U.S. Department of Transportation	138,506	
Total \$ 32,387,631		





Research at Tennessee State University utilizes the diverse skills and expertise of our researchers, faculty, staff, and students to make significant and sustained contributions to the knowledge of humankind through new discoveries that have positive impact on our community, our nation, and the world in which we live. At Tennessee State, we believe research is essential to excellence in education and enhances the educational experience of our students.

> Marcus W. Shute, P.E, Ph.D. Vice President



### **TENNESSEE STATE UNIVERSITY**

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