

Report-booklet of the third edition of the Mali Symposium on Applied Sciences

**Organized by MaliWatch and the Malian Ministry of Education
in partnership with ICRISAT
Bamako, 2-5, August, 2004**

**Sponsored by: The Government of Mali, the Norwegian Trust Funds
for Education, Pall Corporation, the Third World Academy of Science,
the University of Bamako, Graphique Industrie and IER-Mali**

PAPER STATISTICS

region/institution	# of submitted papers	# of presented papers
Total	91	63
Mali	39	38
Other African Countries	30	8
Europe	10	8
North america	10	9
Asia	2	-
Mathematics	11	6
Physics	16	6
Engineering	25	17
Biotechnology	11	8
Education and Language	13	13
Agronomic sciences	7	6
Economics and Law	8	7
FAST	1	1
IPR	6	6
ENI	9	9
MRTC-FMPOS	7	7
FSJE	8	7
ENSup	3	3
CNRST	1	1
EDM	1	1
ICRISAT	3	3
FLASH	0	0

FAST : Faculté des Sciences et Techniques (University of Bamako, Mali)

IPR : Institut Polytechnique Rural (Katibougou, Mali)

ENI : Ecole Nationale d'Ingénieurs (Bamako, Mali)
MRTC-Malaria Research and Training Center at FMPOS
FMPOS : Faculté de Médecine Pharmacie et d'Odonto-Stomatologie (University of Bamako, Mali)
FSJE-Faculté des Sciences Juridiques et Economiques (University of Bamako, Mali)
ENSUP : Ecole Normale Supérieure (Bamako, Mali)
CNRST : Centre National de Recherche Scientifique et technique (Bamako, Mali)
EDM-Energie du Mali (Bamako, Mali)
IER-Institut d'Economie Rurale (Bamako, Mali)
FLASH-Faculté des Lettres Arts et Sciences Humaines (University of Bamako)

MSAS 2004 Report

The 3rd edition of the Mali Symposium on Applied Sciences (MSAS' 04) convened from 2 to 5 August 2004 at the CRES (*Centre régional d'énergie solaire*, at Badalabougou) in Bamako, Mali. The symposium was organized by the MaliWatch Initiative (an international association that works for the promotion of education and research, and actively supports the ideals of good citizenship and volunteer work for the benefit of Mali and Africa) and the Malian Ministry of Education, in partnership with ICRISAT (International Crops Research Institute for the Semi-Arid Tropics). The theme of the symposium was "Malian Meetings for Partnership in Research, Higher Education and Applied Sciences." This four-day meeting brought together approximately 300 participants and experts from different countries in Africa, Europe and North America, attending technical presentations and intensive courses, or participating in workshop debates.

Acknowledgments

The organizers of MSAS' 04 would like to express special gratitude to the sponsors: the Malian Government, the World Bank, Pall Corporation, the Third World Academy of Science (TWAS), and the University of Bamako for their financial support; Graphique Industrie and IER for logistical support. We also express special thanks to invited speakers for their willingness to come to Mali and grant the symposium such a distinguished level of international recognition. These speakers are: Prof. Sylvester James Gates, Jr. from the University of Maryland at College Park (USA), Prof. William Greenberg from VirginiaTech (USA), Prof. Diola Bagayoko from Southern University at Baton Rouge, LA (USA), Dr. Gene Shelp and Len Seed from ENPAR Technologies Inc. in Ontario (Canada), Prof. Nouzha El Yacoubi from the University Mohamed V of Rabat (Morocco), Prof. Libasse Diop from Cheikh Anta Diop University (Senegal), Prof. Akintayo Adedoyin from the University of Botswana at Gaborone, Prof. Abdelhadi Lhassani from the University of Fès (Morocco), Prof. Daouda Sangaré from University of Abobo-Adjamé (Côte d'Ivoire), Prof. Hassimi Maiga from Georgia (USA), Prof. Harouna Maiga from the University of Minnesota (USA), Dr. Eric Allemano from the UNESCO's International Institute for Educational Planning (Paris, France), Prof. Bertin Diarra from Clermont-Ferrand University (France), Dr. Jean Paul Mbelek from the Commissariat à l'Energie Atomique (Saclay, France), Dr. Marcel Moutsiesse from

Centre Gabriel Lamé, Pointe Noire (Congo), Dr. Courfia K. Diawara from Cheikh Anta Diop University (Senegal), Dr. Madian dit Tiéman Diarra from Politechnika Gdanska (Gdansk, Poland), Prof. Sounkalo Dembélé from the University of Franche Comté, Besançon (France), Djeneba Traoré from the Mellon Bank at Pittsburgh (USA) and Dr. Dramane Touré from the Council for Remote Sensing Technology (CNTIG) of Côte d'Ivoire. Obviously, the symposium could not have succeeded without them. We would also like to thank the Local Organizing Committee members. Their desire to foster increased public dialogue and awareness of the symposium is greatly appreciated. Members of the LOC are: Dr. Ouaténi Diallo (FAST), Pierre Sibiry Traoré (ICRISAT), Omorou Zackaria Touré (FSJE), Dr. Abdoulaye Sidibé (IPR), Dr. Daouda Coulibaly (ENI), Dr. Boubacar Kane (EDM), Labass Lamine Diallo (MEN), Dr. Adama Tolofoudye (FAST), Bakary Sakho (BECI), Lamine Coulibaly (LAMCO), Mme Goudiam Maimouna Diakité (TOKTEN), Dr. Mahamadou S. Sangaré (ENSUP), Dr. Sidi B. Sokona (ENSUP), Seydou Houssouba (FSJE), Fatoumata Cissé (Grand Hôtel). Many thanks to Prof. Dialla Konaté of VirginiaTech (USA) who could not attend but made valuable recommendations and introduced us to Prof. Greenberg, the latter came as invited speaker and kindly accepted to present Prof. Konaté's papers. Thanks also go to Prof. Alhousseini Bretaudeau from IPR/IFRA (Mali) who, because of an accident, could not attend but contributed to the organization with insightful advice. We are grateful to Mohamed Alhousseyni Touré (World Bank, Rwanda) for his precious encouragements and valuable remarks, Seydou Thiam (World Bank, Washington, D.C.) for actively backing up the organizational effort, the Mali Embassy in Washington, D.C. for administrative assistance, Afribone for advertising, the TOKTEN Project for housing support, and the Malian radio and television broadcasting service (ORTM) and national newspaper (*L'Essor*) for media coverage. Finally we would like to express our sincere thanks to all the symposium participants for their valuable contribution to this 3rd edition of MSAS.

(Refer to Image 2 : A view of participants at one of the sessions)

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Executive summary

From Monday, August 2 to Thursday, August 5, 2004, distinguished scientists, teachers, researchers, officials and students from Mali and many different countries in Africa, Europe and North America gathered at the CRES in Bamako (Mali) for the 3rd edition of the Mali Symposium on Applied Sciences. This four-day symposium, which included 13 conference sessions and workshops, was the first significant scientific forum ever held in Mali to focus on a wide range of applied and social sciences. The Symposium was organized around disciplinary clusters covering the topics of: Pure and Applied Mathematics, Theoretical and Applied Physics, Biotechnology, Engineering Sciences, Environmental Sciences, Education and Languages, Agronomic Sciences, Law and Economics. Each day addressed different themes in concurrent sessions featuring specialized and original papers by the various presenters. Abstract booklets were prepared along with the program and distributed to the symposium participants. The organizers had the following objectives:

- To provide a solid scientific foundation for future public policy discussions on research and higher education in Mali and the rest of Africa;
- To invigorate and deepen public debate about academy and industry relations;
- To create a platform of work for high-level scientific exchanges between Mali, Africa and international scientific partners;
- To provide Malian and other Africa-based scientists with an opportunity to present and publish original research results;
- To strengthen collaborative research ventures between Africa and other regions of the world by promoting exchange visits of scientists;
- To encourage the creation of common doctoral programs across Africa;
- To provide Malian and African students with an opportunity to attend intensive courses taught by highly qualified professors and researchers;
- To assist Malian and African researchers in the conception and development of research projects and proposals, with input from African and international experts.

Our hope was that a candid look at all these objectives by key actors of the academic and research community, coming from Mali and overseas, would significantly elevate public discussion and scientific cooperation.

Since the goal of this symposium was to catalyze broad discussion on research and higher education in Mali and Africa, in addition to technical presentations, a general public policy debate, a session on health situation in Mali concerning the high rate of maternal death during childbirth and a session on academe-industry relations explored the many difficult issues related to research and technology in Africa. To this end, we had invited qualified and forthright presenters from both the academe and industry.

MSAS' 04—the first broad appraisal of research in applied and social sciences—was largely open to the public and is now available on videotape as well as on DVD. Attendance was diverse with various disciplines represented. High-school students lined up at the door along with undergraduates, research scientists, professors, writers, journalists, school teachers, and the interested general public. Attendees came in from numerous academic, industrial and governmental institutions in Mali and from overseas. Thoughtful print and broadcast pieces have discussed the event and the importance of research in Mali and Africa.

Abstract booklets were prepared along with the conference programs and distributed to all the participants. Authors have the option of submitting a full version of their paper for review and possible publication in the proceedings.

(Refer to Image 3 : Prof. Gates answering questions from Malian students at the banquet. At his right, prof. Seydou is translating)

Symposium Overview

The symposium opening ceremony was presided over by Prof. Mamadou Lamine Traoré (Malian Minister of Education). Switzerland-based Dr. Mohomodou Houssouba, writer and member of MSAS Executive Committee, chaired the Symposium's opening session. He welcomed participants to MSAS'04 and described the expanding reach of MSAS from national to regional and international scope throughout the successive editions. Dr. Ouateni Diallo, the MSAS local coordinator and researcher at the University of Bamako, stressed the importance of the event and thanked MaliWatch for the initiative, the sponsors for the support and all participants.

Djeneba Traoré, general coordinator for the MaliWatch Initiative, provided an overview of the association and its projects, summarizing its mission and highlighting the duties and accomplishments of its members in Mali and abroad.

Dr. Abdoulaye Doucouré, researcher at Pall Corporation (New York) and member of MSAS Executive Committee, commented on the importance of the Symposium's topics, briefed participants on the history of MSAS, underlining the contents of MSAS' 04. He emphasized that this Symposium was a presentation of various studies and research projects conducted by scholars, scientists and experts working across the disciplines covered by the symposium.

Prof. Diola Bagayoko, the honorary president of MSAS, acknowledged that the organization had drastically improved and stressed the importance of cooperation for promoting education, research and the application of scientific works in Mali and Africa.

Prof. Sylvester James Gates, the plenary guest speaker, thanked the symposium organizers for inviting him to Mali. He then detailed his work for promoting science on the African continent, especially in South Africa through the South African Physics

Society. He finally briefed the participants on the importance of intellectuals in a country and how the diaspora may play in its technological and economic development.

Prof. Mamadou Lamine Traoré, Minister of Education of Mali, first thanked “the dynamic Malian young researchers” for the organization, then Professor Gates and other invited speakers for coming to Mali, as well as all the participants. He enumerated the difficulties encountered by researchers in the country and noted the special opportunity offered by the Symposium to exchange with the outside world and locally improve the quality of higher education and research. He indicated that MSAS would be institutionalized and that support to the organizers should be broadened. He then declared the symposium officially open.

A break followed the opening ceremony before sessions resumed for the remaining four days. These sessions are outlined in the symposium program, and abstracts of all the presentations are included in the abstract booklet. Proceedings will be published in 2005 and distributed to the participants and the sponsors.

The closing ceremony was chaired by Dr. M. Houssouba, and featured three special messages. First, Dr. Fad Seydou, MSAS President, thanked the participants for their trust and for their active involvement in MSAS’ 04, which made it a successful event. He then invited students to register for MaliWatch membership and take part in the organization of future MSAS editions. Bakary Sakho, local coordinator for MaliWatch, followed by summarizing MaliWatch activities and thanked all the participants for contributing to the success of MSAS’ 04. Closing remarks were delivered by Dr. Mamadou Keita, technical advisor to the Minister of Education, who expressed his delight as a privileged witness to the energizing impact of MSAS on Mali’s academic and research community. He urged all intellectuals from the African diaspora to renew efforts to enhance research and higher education on the continent and brought an official end to the Symposium.

Apart from technical presentations, MSAS participants visited the national laboratories like the Laboratory of Applied Molecular Biology, university colleges and specialized research institutes. There was a particular interest in new and affordable technology for producing drinking water in Mali and other semi-arid regions. The process which relies on Capacitive Deionization (CDI) was introduced by ENPAR, INC. representatives to the different audiences.

(Refer to Image 4: MSAS’ 04 volunteer students of the local organizing committee)

Dr Adama Tolofoudye, professor of chemistry at the FAST, had set up appointments for Dr Gene Shelp (CEO) and Len Seed (Chief Engineer) from ENPAR Inc. in Canada, and Dr Abdoulaye Doucoure, researcher at Pall Corporation - a US group specialized in filtration, separation and purification processes. Their objective was to discuss issues on drinking water production, municipal and rural water treatment, as well as wastewater management, with officials from the following institutions:

- National Direction for Hydraulics
- National Laboratory for Water Quality
- Ministry of Energy, Mines and Water
- Institute of Rural Economy
- Ministry of Environment and Purification

During these meetings, ENPAR presented “DesEI”, a technology used to remove total dissolved solids from brackish water and seawater, based on Capacitive Deionization (CDI) scientific principles. CDI primarily serves to remove electrically charged contaminants from water streams and produce pure water. This technology has been investigated over four decades but ENPAR electrochemists exploited it for water applications and adapted it for treating high total dissolved solids (TDS) water solutions (i.e. > 5g/L TDS). Over the years, ENPAR has developed very strong relationships with the Council of Scientific and Industrial Research, a governmental South African agency. Both partners recently set-up a business alliance aimed at fully manufacturing DesEI in South Africa, to facilitate its distribution and utilization in many regions of Africa. The main benefits of DesEI - that makes it attractive for a country like Mali - are outlined below:

- a) DesEI operates with direct current and consumes small energy (1-2 V). This makes it perfectly suited for coupling with photovoltaic units, so it can equally serve small communities in remote areas as well as large cities – i.e. excellent scalability.
- b) DesEI needs minimum maintenance, with a life cycle of about 8 years for the current electrode systems.
- c) The typical recovery rates exceed 90% over a wide range of TDS conditions.
- d) Limited pretreatment is needed: suspended solids removed with a cheap 15-micron pre-filter — no need for chemical pretreatment.
- e) Drinking water is produced upon removal of all metal/inorganic ions including iron, chromium, arsenic, lead, perchlorate, nitrate, nitrite, chloride etc.

The Ministry of Environment and Purification and the National Direction of Water Management showed a great interest in this process and decided to order two bench scale units for further evaluation.

Appreciations and Recommendations

Before the closing ceremony, participants were offered the opportunity to give their impression on the symposium and present options for enhancing future meetings. The

excellent quality of contributions from world-class scientists, such as professor Sylvester James Gates, Jr. and other speakers from many different countries impressed the audience. Many attendants praised the organizers for efficiently addressing recommendations from MSAS previous editions and expressed their appreciation for the significant organizational improvement. For instance, the government and the university worked hand in hand with the various MaliWatch-MSAS committees and brought a substantial logistical and financial support, the symposium was extended to social sciences, the local organizing committee -where each faculty of Bamako university and research institute is represented- was extremely energetic, and the information policy and briefing about MSAS were presented early to the local researchers and students. Many first time participants stressed that MSAS'04 far exceeded their expectations and promised to come back for the next edition with other colleagues. Finally, many guests emphasized that it was essential for scientists and researchers who participated in MSAS to keep interacting after the conference, in order to improve standards of higher education and research in Africa.

The organizers retained the following recommendations for the forthcoming symposia:

- The symposium must be institutionalized, with the creation of a permanent local office.
- Greater visibility should be given to the parallel sessions (earlier briefings and better directions were suggested).
- Professional equipments should be utilized more extensively for translation.

MSAS' 04 Honorary President

Prof. Diola Bagayoko. He received his Ph.D. from Southern University and A&M College, Baton Rouge (SUBR) in 1983 for studies in Theoretical Solid State Physics

Diola Bagayoko is Distinguished Professor of Physics and Chancellor's Fellow at SUBR (1994-Present). He teaches or has taught courses in Introductory Physics, Mathematical Physics, Classical, Relativistic, and Quantum Mechanics. He served as Academic/Research advisor to many students, revised course content (undergraduate and graduate courses) and syllabi to explicitly take into account the taxonomy of the cognitive domain, recent research findings on cognition, and standards of graduate schools and high technology industries.

Prof. Bagayoko established and currently directs the Timbuktu Academy, a national model program for mentoring pre-college, undergraduate and graduate students in USA. He received a US Presidential Award for Excellence in Mentoring in 1996 and a National Exemplary Undergraduate Program Award from Quality Education for Minority (QEM) Network in 1996.

Prof. Bagayoko's nationally recognized Timbuktu Academy works with financial support by the National Science Foundation (RCMS Program) and the Louisiana Board of Regents. A major funding from the Department of the Navy, Office of Naval Research (ONR), has expanded the Academy in 1993 to "mentor one hundred (100) pre-college students per summer, fifty (50) high-achieving college students majoring in physics, engineering, and chemistry, and to affect, positively, over 5000 pre-college and college students and their parents per year." He has also recruited and mentored, thanks to additional funding from NASA, NIST, NSF, and SUBR, additional physics, engineering, and chemistry majors per year, including five (5) NASA-USRP scholars.

Prof. Bagayoko published more than 100 research papers in electronic, cohesive, magnetic, optical, and other properties of metals, oxides, and polymers. He introduced applications of the power law of human performance and of the concept of cognitive condensation in teaching and learning (presented at MSAS' 04). He also introduced, with colleagues, the Bagayoko, Zhao, and Williams (BZW) procedure, which opened the way to predictive calculations of electronic and related properties of semiconductors.

In his administrative duties, Prof. Bagayoko served as Director of the Office of Grants, Sponsored Research, and Faculty Development, 1987-1989. As project director, he has managed research and instructional grants and contracts over \$1,000,000 per year from 1993 to 1998, and over \$2,000,000 per year from 1998 to present.

MSAS' 04 Honorary Plenary Speaker

Professor Sylvester James Gates, Jr. received his Ph.D. from the Massachusetts Institute of Technology (MIT) in 1977 for studies in Elementary Particle Physics and Quantum Field Theory.

Sylvester James Gates, Jr.'s postgraduate studies began with his appointment as a Junior Fellow of the Harvard University Society of Fellows (1977-1980) and continued with an appointment at the California Institute of Technology (1980-1982). He has been a faculty member at MIT (1982-1984) and the University of Maryland at College Park (1984-present). From 1991-1993, Professor Gates took leave of absence from the University of Maryland to serve as Physics Professor and Department Chair at Howard University.

Prof. Gates has authored or co-authored over 120 research papers published in scientific journals, co-authored a book and contributed numerous articles in others. He travels widely to speak at national and international scientific meetings. His research, in the areas of the mathematical and theoretical physics of supersymmetric particles, fields and strings, covers topics such as the physics of quarks, leptons, gravity, super and heterotic strings and unified field theories of the type first envisioned by A. Einstein.

Prof. Sylvester Gates' study of the mathematical laws that govern hypothetical forms of energy and matter have paved the way for the 21st century exploration of the universe at tiny scales never before previously accessible.

Professor Gates shares the N.T.A.'s 1993 Technical Achiever of the Year Award with astronaut Dr. Bernard Harris and also received the recipient of the N.T.A.'s 1993 Physicist of the Year Award. Professor Gates was chosen to be the first recipient of the American Physical Society (APS) **Bouchet Award** and became a Fellow of the APS in 1994. Sylvester James Gates, Jr. was inaugurated as the first John S. Toll Professor in Physics at the University of Maryland, College Park.

MSAS Executive Committee Members

Prof. Fad Seydou: President of MSAS. Dr. Seydou holds a position of researcher at the Department of Electrical and Information Engineering and of adjunct professor (Docent) at the Department of Mathematical Sciences at the University of Oulu, Finland. He is also visiting professor at the University of Maryland, College Park (USA).

Dr. Abdoulaye Doucouré: MSAS director of cooperation and fundraising. Dr. Doucouré is a senior researcher at Pall Corporation in New York.

Dr. Doulaye Dembélé; MSAS editor in chief. Dr. Dembélé is research scientist at the CNRS-Parc d'Innovation Illkirch/University of Strasbourg, France.

Dr. Mohomodou Houssouba; MSAS director of information and communication. Dr. Houssouba is a writer in Basel, Switzerland.

Bakary Sylla: MSAS director of academy-industry relations. Mr. Sylla works as a wireless radio and cellular software engineer in Dallas, Texas, and Mexico City.

Dr. Ouaténi Diallo; MSAS local coordinator. Dr. Diallo is assistant professor at the FAST Mathematics Department of the University of Bamako.

Policy Recommendations

In Mali and in the region, people have become aware that education and active participation in scientific research and technological innovation determine a country's capacity to generate an educated and productive population. To have an economic impact, all public and private efforts must converge to raise the level of higher education. A low-quality higher education will produce poorly trained teachers incapable of stimulating enthusiasm and scientific creativity among the students.

Also, in a country which lacks basic infrastructures of technical support, scientific meetings and research laboratories, very few professors and researchers manage to present their ideas, submit their results to the peer review process, and compete with the best in the world. Moreover, the teaching staff is not only insufficient in numbers but largely made up of adjunct and assistant instructors without a career plan, research

facility or even an office. As freelance instructors working on short-term contracts, they have little incentive to invest much time in teaching or research.

With all these persisting problems, the organizers of MSAS' 04 vow to follow through with the ideals of MSAS to achieve all its objectives. They will also work closely with African intellectuals to convince the African governments, corporations and general public that:

- the investment in scientific research will bring economic development and a better quality of life for the population;
- a culture of research is crucial for the development of technology and the advancement of any society;
- university research plays a key role in raising the technological prospects of the private sector;
- discoveries and patents are primary indicators of scientific activity and the culture of innovation in an economy. This activity is traditionally measured by the production of scientific publications;
- knowledge, know-how and information are critical factors of high-quality production. Access to the Internet will facilitate the communication within the research community, enable affordable and sustainable exchanges between expatriate and resident researchers;
- in a market which becomes increasingly competitive it is necessary to develop programs encouraging scientific research. The researchers of Mali and Africa must have the means to work and distribute the results of their activity;
- universities should seek to achieve international recognition in specific fields by sponsoring cutting-edge research through qualified staff. In this way they can increase the knowledge base, develop and improve scientific pedagogy and encourage the application of science to improving the quality of the life and the wellbeing of the community;
- universities must have as a vision, in the long run, to be internationally recognized and respected in all the fields of social, pure and applied sciences. They will contain centers of excellence known in the whole world and they will have an important role as supplier of higher and post-doctoral university training schemes of high quality;
- the numbers of students in doctoral programs must be increased significantly;
- universities should also try to increase the extent of the cooperation with other institutions of research and develop south-south collaboration;
- Mali and other francophone African countries must also enhance the extent and quality of instruction provided in English. This objective is critical to the strategy of internationalization of the educational policies of the university.