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Standardization and Measurement Services in the Sudan

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H. Steffen Peiser, Benjamin M. Gutterman, Gain L. Louis, Joan M. Pring, John K. Taylor, Albert D. Tholen

Editor: Cathy A. Smith

Office of International Relations
National Bureau of Standards
U.S. Department of Commerce
Washington, DC 20234

Held February 25 - March 8, 1978
Issued August 1980

Survey Director: Honorable Sayed Abdel Atif Widaatalia
Deputy Minister
Democratic Republic of the Sudan

International

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U.S. DEPARTMENT OF COMMERCE

NATIONAL BUREAU OF STANDARDS

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Prepared for
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Department of State
Washington, DC 20523

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I. Executive Summary

A ten member international team advisory to the Government of the Sudan's Ministry for Industry on Sudanese standardization and measurement services was organized by the U.S. National Bureau of Standards with financial support divided about equally between the U.S. Agency for International Development and the Sudan. The team function was to survey Sudanese standardization and measurement services in support of development and consisted of the Secretary General of the Arab League Organization for Standardization and Metrology, the Assistant Secretary General of ASMO, senior representatives of the standardization communities of Indonesia, Morocco, the United Kingdom, and four members of U.S. standards agencies. The Sudan provided a local counterpart Survey Team of fifteen senior officials under the chairmanship of the Deputy Minister for Industry and the organizational directorship of the Acting Director General of the Sudanese Department of Standardization and Quality Control. In the two weeks in which the combined team traveled in the Sudan, the international visitors put their collective knowledge and experience at the disposal of Sudanese colleagues. The Survey was excellently organized by the local team members who spared no effort or expense to make the Survey successful. Feelings of unanimity on the importance of the Survey mission led to understanding and lasting personal friendships between team members.

In Section II, Introduction, the report describes NBS activities in support of development activities of AID including previous similar surveys and the discussions between the Sudanese authorities, NBS, and ASMO, that led to the plan of this Survey.

In Section III, Background, a thumbnail sketch of the Sudan is followed by an analysis of the previous year's report on "National Standards" by Dr. R. S. Winser, under the auspices of UNESCO and UNDP. The function of this Survey in effect was to reemphasize the sound views expressed in the Winser Report regarding the importance of standardization and measurement services in a developing economy. Rather than duplicating the Winser study, the Survey Team set out to disseminate the message on the widespread benefits of standardization and measurement technology to selected sectors in the Sudan with the assistance of highly experienced technical experts from the corresponding sectors in other nations. The detailed mechanism outlined in the Winser Report for organizing infrastructure services in standardization in the Sudan is recognized as one solution of the existing desperate need. Without such an infrastructure, development in the Sudan will be slowed and made more costly. The Survey Team, however, feels that the mechanism, which is proposed in the Winser Report and which would be provided by one centralized agency, is only one good choice at the disposal of the Sudanese Government. Another

good alternative is to build on existing institutional expertise through a process of interagency coordination and cooperation, including the universities and the private sector. The Department of Standardization and Quality Control would need encouragement to see its mission and expertise extended to benefit other sectors--such as communications, health, nutrition, building, etc., without seeking regulatory authorities clearly established in other ministries. Similarly, the Institute for Industrial Research and Consultancy could be more widely recognized as an existing unexcelled institution for standard measurement methodologies and test facilities coupled with a staff with good technical background.

Yet another option can be based on the successful example of the Sudanese textile industry that looks to Khartoum Polytechnic to prepare students for their future technical role in industry. Similarly, the Engineering Faculty of the University of Khartoum could take a much more active role in preparing students for contributing to the technology of measurement throughout Sudanese industry and commerce. Ultimately, it is for the Government to recognize these functions as of primary relevance to development and then to decide whether to strengthen the existing organizations or to transfer the functions of standardization, quality control, and measurement to one new organization not tied to any one ministry as the Winsor Report suggests.

In Section IV of the Report, the itineraries are described. All 48 Sudanese organizations in government and industry were visited, some several times, so that specialist groups within the team were given an opportunity to appraise the use and to identify unfulfilled needs for standards and measurements to benefit these sectors. It is through the open discussions at all these visits that the principal benefit of this Survey should be seen. The notes on these visits can only partially reconstruct the useful technical exchanges that occurred.

In Section V, the team subgroups on food industries, weights and measures (in retail markets), chemical industries, standards and quality control, and textiles report their conclusions through their appointed coordinators, in accordance with similar summaries and warm personal appreciations presented verbally to the Minister of Industry at the end of the Survey. Mr. B. M. Gutterman, speaking as coordinator for the Food Industries Group, praised the industry, its enormous potential, and the existing competence in standardization. However, the group saw the urgent need for development of consensus standards, and the possibility of costly losses for lack of standards in production, storage, containerization, and handling. More education, greater number of specialists, and a careful choice of research topics would be found to be cost effective in this field, especially in the future when the Sudan could look forward to far greater food exports.

Mr. A. D. Tholen, speaking for the Weights and Measures Group, represented a sector in which the Sudan can proudly show a well-organized and coordinated group that provides a technically sound consumer-oriented service to retail markets. Moreover, under the Ministry of Commerce, this program has itself produced a sound expansion plan, including noble metal assays, for a rising standard of living, quality of life, and consumer consumption in the Sudan. In detailed comments the group saw some fields, e.g., of weighing large masses, where the need was outstripping existing capabilities. They pinpointed some areas, e.g., prepackaged goods, in which a revision of the basic law was needed. Written procedures for measurement device examination are advocated. The greatly increased training plans are strongly endorsed. Most of all, the group feels that the planned upgrading of the laboratory facilities, the increase of staff at existing local branches, and the number of such branches, far from being too ambitious, are probably too modest by far. Whenever a country expects to control a trade volume by an authority funded by much less than a thousandth part of the value of that trade, wide technical competence and relative freedom from fraud cannot be achieved even with the most highly competent and devoted staff. In another country, a similar Survey Team estimated that the loss to the consumer through fraud at the point of sale averaged approximately 4 percent.

Dr. J. K. Taylor, coordinator for the Chemical Industry Group, reported a growing, well motivated industry where discussions on measurement and standardization were welcome. Problems of standards in import, export, communications, and transportation naturally affected the chemical industry also. Analytical facilities are lacking the convenience and cost effectiveness of modern instrumental methods, with a consequent loss of applicability of chemical analysis to production controls in chemical industry. Equally serious to the hoped for expansion of this industrial sector is the apparent lack of awareness of the usefulness of standard reference materials. A self-reliant, small-scale chemical industry can only establish itself in the Sudan with a central chemical measurement service function which needs a capital expenditure equivalent to several million dollars. It could be based, for instance, on the existing Industrial Research and Consultancy Institute.

Miss Joan Pring, coordinator for the Standards and Quality Control Group, reported that as in all other countries visited by NBS/AID Survey Teams, the levels of understanding of standardization concepts varied from good to poor.

However, an examination of the various systems of any country showed that a high degree of standards activities benefited all. The implementation of the principal recommendations of the Winser Report is strongly advocated including a standards law for a strong national standards capability coupled with mechanisms for good coordination between agencies such as the present Department of Standards and

Quality Control, the Industrial Research and Consultancy Institute, and others.

Mr. Gain L. Louis reported as coordinator for the Textile Group. There was a great deal of standards competence in the industry. Quality control is well practiced in some larger mills, but if world-wide competitiveness is an aim of this Sudanese sector, it needs to be universally applied. Standard labor and safety practices are advocated to reduce costs. Standard humidity control would probably eliminate the "honeydew" problem, caused by a sticky, sugar-like substance which seriously affects processing and quality of the product. The assistance from the People's Republic of China and the training of textile technicians at the Khartoum Polytechnic are highly praised. Lack of standardization of replacement parts for textile machinery from many parts of the world is a problem faced by an effective small-scale Sudanese support industry to supply most spares. The leaders of this industry had listened with interest to a lecture on U.S. research in support of the cotton textile industry.

II. Introduction

At the request of the U.S. Agency for International Development, the National Bureau of Standards has since 1970 engaged in experimental projects of consultation and support for less developed countries. The objective is to assist their own efforts in building up a technical infrastructure in standardization and measurement services. Without such infrastructure, no country has succeeded in economically viable industrialization programs, which are on the development schedules of almost all AID countries.

One of these NBS projects is to arrange for a visit to such a country for an international team of about ten expert consultants at the request of its Government. These consultants would survey for a period of two weeks the relevant facilities and expertise, available or needed, and place their knowledge and experience at the disposal of the host country. They would visit and consult with Government, industry, and academic leaders on previously requested topics concerned with standardization or measurement technology.

When members of the Sudanese Government heard and studied such NBS/AID Surveys to Ecuador, Turkey, Korea, Thailand, Bolivia, and the Philippines, they showed an interest and decided to consider requesting AID to undertake such a Survey of Standardization and Measurement Services in the Sudan. NBS had not previously undertaken such a mission to an Arab country but had successful projects in cooperation with the Arab League Organization for Standardization and Metrology of which the Sudan is a member country. NBS requested ASMO participation in the proposed planning and possible execution of this Survey. The enthusiastic approval by both ASMO and the Government of the Sudan convinced NBS to go forward with planning a Survey in the Sudan. H. Steffen Peiser, Chief of the NBS Office of International Relations, made an exploratory visit to Khartoum in December 1977 from which he reported in part as follows:

Purpose of Trip: Accompanied by a representative of the Arab Organization for Standardization and Metrology (ASMO) to discuss with the Ministry of Industry of the Democratic Republic of the Sudan the proposed NBS/ASMO/AID Survey on Standardization and Measurement Services in the Sudan.

Accompanied by: Abdulla Fadlalla, Assistant Secretary General,
ASMO

Trip Summary: An exploratory visit was undertaken to Khartoum to decide on the implementation of the proposed plan for a February/March 1978 NBS/ASMO/AID Survey of Standardization and Measurement Services

in the Sudan. I was fortunate to be guided by Engineer Abdulla Fadlalla, Assistant Secretary General of the Arab Organization for Standardization and Metrology and former Deputy Minister for Industry of the Sudan. He has close friends in all relevant departments and it is due to him that a widely accepted plan could be elaborated and accepted wholeheartedly by the Minister for Industry, Dr. Bashir 'Abbadī, whom we first met on arrival at the airport late on December 13.

Visits on December 14

At the Department of Standardization and Quality Control (DSQC) of the Ministry of Industry, the Director General, Mr. Suliman, met us although he was on leave, while his deputy, Mr. Ahmad Lutfi, was given the responsibility of organizing the proposed survey.

The following specialized topics were to be included in the Survey:

1. Food - Visiting team
Fadlalla/Gutterman
2. Weights and Measures - Visiting team
Kiranne/Wollin
3. Chemical Industry
Awni/LaFleur
4. Standardization Committees and Interagency Coordination
Salama/Peiser
5. The machine industry and dimensional metrology was unfortunately not favored by the Sudanese Government, but contrary to previous indication, a strong request was made for the cotton textile industry. I promised to organize a visiting team pair. Building technology also was not favored as a specialized topic.

Apart from plenary meetings on the first and last days, most of the activities of the survey will be split by subgroups.

For prior reading by the visiting team, Mr. Lutfi recommended:

1. "Applied Metrology--A Survey of Existing Metrology Facilities," by S. Abbott, June 1972.
2. "Standardization in the Arab World," by A. Sharif, UNIDO.
3. "Sudanese Council for Research Standardization and Metrology," by R. S. Winser, formerly of BSI under the auspices of UNESCO.

There existed an Investment Law of 1968 which related to standardization. Library facilities and ASMO contacts are said to meet Sudanese present needs. Mr. E. A. Awad, who corresponded with NBS in 1975, still is on the staff of DSQC.

At the Industrial Research and Consultancy Institute (IRCI), we were, in the absence abroad of the Director, received by the Head of the Administrative and Financial Department, Mr. Mohed Hafiz Elsanhory. The Institute has test laboratory facilities used extensively by the DSQC. IRCI will support and cooperate with the proposed survey. The interests of IRCI in building technology again was not mentioned, but during the Survey, I will try to be in touch with the specialists who have visited and impressed CBT of NBS (Mr. Obeid and Mr. Mowaia El Sheikh).

The Standards Section of the Ministry of Commerce and Supply (SSMCS) is concerned with weights and measures as well as in the future with gold and silver assays. We were received by Mr. Babiker, who spent two years with the Board of Trade in London. He, too, was clearly looking forward to participation in the Survey in expectation of benefit to SSMCS.

Although the Minister of Commerce and Supply, the Hon. Mr. Haroun, was known to favor the Survey, it proved impossible to arrange a meeting. When we left our cards, however, we were most encouraged in our plans by Underminister Mohieldin Mogood Shora and other senior officials, including Secretary Ali Eltahir Hassan.

We had a thorough and meaningful discussion with Mr. Gordon Peirson, U.S. Agency for International Development representative in the Sudan. He was interested in NBS functions in the United States and its proposed reorganization. He focused attention on possible implementation of recommendations of the Survey and emphasized that he was interested in the Survey without being able to offer direct support. Moreover, he wanted it to be clearly understood that his Mission was in no way committed to any implementation projects. He also emphasized that the formal approach to his Mission from the GOS was now very urgent if we insisted on the February 24th start.

At the formal meeting with the Minister of Industry attended by the Underminister for Industry, Mr. Lutfi, and others, we were given the opportunity to describe our plans in some detail. The scheme was given the Minister's full approval. Funding and formal approach through the GOS Planning Commission would be initiated without delay.

In our farewell discussions, Mr. Lutfi correctly emphasized the need for rapid and clear communications for planning the technical itineraries. I undertook to request survey participants to write down as soon as possible their wishes and ideas of visits they would like to have arranged. Personally, I have admired the Sudanese support and participation in the U.N. University programs and would like to be in touch with the groups concerned, I guess at the University of Khartoum.

I also believe each of the team members from abroad should be prepared to offer one lecture to any interested audience. Team members should communicate the proposed title as soon as possible. My title might be "The Outcome of Previous Country Surveys on Standardization and Measurement Services." These lectures will presumably be in the

evenings followed by a discussion, all with small audiences. The rest of the day's work appears to end at about 2 p.m. when as many as possible of the members from abroad should try to interact with each other over lunch. The team from abroad will invite our Sudanese friends and colleagues to an evening dinner at the Khartoum Hilton on Wednesday, March 8.

A separate project under the NBS/AID program for development is to organize regional seminars on selected standardization topics. NBS provides guidance, discussion, and publication of such seminars of interest to a group of countries in a region. ASMO had proposed such a seminar in the Sudan immediately following the Survey on "Standards and Measures in Industrial Development." Whereas NBS was prepared to concur with that idea also, Mr. Lutfi considered the planning time too short and favored postponement of the NBS/ASMO/AID Regional Seminar until after there had been time to assess the implementation and effects of the Survey. While agreeing to that postponement, Peiser was not authorized to commit the funding for such an indefinite time in the future. However, NBS would continue to be open for such a proposal provided suitable outside funding could be obtained.

So the plans for the Survey went ahead in exact accordance with the proposals made by the Government of the Sudan. Team arrival in Khartoum was arranged for on or before Friday, February 24, 1978.

NBS was fortunate to assemble a most distinguished and qualified visiting team for the Survey. ASMO was represented by its Secretary General, Dr. Mahmud Salama, and his Assistant Secretary General, Abdulla Mohammed Fadlalla. The organizational leadership was provided by Mr. H. Steffen Peiser, Chief of the NBS Office of International Relations. NBS invited the British Standards Institution to provide a team member in view of the historic relationship between Great Britain and the Sudan, and especially because of the excellent previous study on the Sudanese "National Standards" by Dr. R. S. Winser, working on behalf of the U.N. Development Program through UNESCO. BSI accepted and selected Miss Joan M. Pring, Joint Secretary (International). The regulatory agency for weights and measures in retail markets of Morocco is headed by Mr. Mohamed Benkirane, who also chairs the relevant ASMO subcommittee. His survey team membership was welcomed by all parties. Mr. Herudi Kartowisastro is Director of the National Institute for Instrumentation of Indonesia and is secretary of the country's Committee for Calibration, Instrumentation, and Metrology. The Indonesian Government and National Institute of Science readily agreed to Mr. Kartowisastro's participation in the international team. Since food standards are not part of the NBS mission, the U.S. Food and Drug Administration made available Mr. Benjamin M. Gutterman, Assistant Director for Technology, Bureau of Foods. Similarly, NBS is indebted to the Agricultural Research Service of the U.S. Department of Agriculture for permitting Mr. Gain L. Louis, with outstanding experience in cotton textiles, to join the team. Finally, two of

Peiser's colleagues at NBS, Dr. John K. Taylor, a most experienced analytical chemist, and Mr. Albert D. Tholen, Chief of the NBS Office of Weights and Measures, completed the team that certainly had wide knowledge in standardization within the five topics selected by the Government of the Sudan: Food, Weights and Measures, Chemical Industry, Standards Committees and Interagency Coordination, and Cotton Textiles.

III. Background

Within the Sudan, a large African country, remarkable climatic and cultural transitions occur. The Niles, the Red Sea ports on the north-east, the desert in the west, the many mountainous areas and the rainy equatorial south all impart their diverse characteristics to a country rich in natural and human resources. The educational level of much of the population is at present inadequate for many trades and professions. The most highly educated Arab population, therefore, is predominant in Khartoum and in government agencies, but participation by persons of partial Negro or Berber descent is by no means discouraged. Arab people lay stress on loyalty, individual pride, friendships, traditions, and religious observances. Agriculture with Sudan is highly productive and gives promise of much further expansion. Potential ample food for all Arab nations could be grown here near the banks of the Niles. Cotton and food processing as well as some manufacturing have developed in the Sudan, but some infrastructure systems such as transportation have lagged and slowed progress. There has been wide-spread self-criticism that standardization, quality control, and measurement technology are now inadequate for the current needs of the country.

Earlier in 1977 a UNESCO planning team has reported on a comprehensive six months' study on "Science and Technology Policy, Planning, and Management in the Sudan." Among the eight parts of this study was that conducted by Dr. R. S. Winser, an experienced British standards specialist, on "National Standards." His carefully considered recommendations can be summarized as follows:

Responsibility for standardization in the Sudan should be placed firmly in one strong autonomous National Standards Organization established by law. It should also have authority on a reimbursable basis to issue certificates of conformity with standards as quality assurance of selected products especially where health safety and international trade are involved. This organization should be supervised by a Council in which many ministries and other major interests would be represented, and it should be placed under the auspices of the National Planning Commission, a supra ministerial body. The certificates would be based on tests performed at accredited laboratories in the public and private sectors including the universities. The National Standards Organization should provide an instrument calibration unit in conjunction with a recording system of all equipment used for testing or measuring. This function could be delegated to the National Council for Research. Manufacturers should be expected to have quality control systems under the surveillance of the National Standards Organization, whose staff would also be competent to offer professional advice on appropriate test and control procedures. The Winser Report also stresses the considerable training

requirements, the essential considerations of an attractive salary structure, the effort needed to create an awareness of the importance of standardization throughout all sectors, the support of standardization through government purchasing procedures, and the office facilities and skills needed to operate a standards committee structure. Significant suggestions are made in appendices for job descriptions and a law to provide for the establishment of the Sudanese Organization for Standards and Quality Assurance.

With such a comprehensive report in the hands of the Sudanese Government, it may seem surprising why the interest in an NBS/AID Survey developed. The preliminary discussions with Peiser could have left little doubt that the elements and functions of a standardization system would again be recognized during the Survey and they would not greatly differ from those specified by the Winser Report. Maybe the Government wished simply a confirmation of Winser's recommendations. It is likely that an advantage was seen in the diverse expertise available for the Survey Team to make more specific recommendations in sectors of importance to the Government. It is also possible that implementation of Winser's recommendations was delayed by the rather rigid organizational proposals that were made. In the preliminary discussions, Peiser had stressed that whereas standardization and measurement was of critical importance in all development, the mechanisms for achieving a national standards system were open to wide-ranging choices depending on political, cultural, existing institutional, and other considerations which best suited self-reliant decisions by Sudanese sovereign authorities. It is true, of course, that one single National Standards Organization can be a very good national choice, but it is only one of several institutional arrangements. In fact, it is neither the one which has developed in the United States or Britain nor is it that chosen by Egypt and India after their independence. NBS/AID was not likely to attempt to make such specific recommendations on organizational mechanisms. After reading the Winser Report, Peiser recommended to the team members to avoid undue overlap with the previous study, and to avoid unnecessary comment on decisions best left to the Government of the Sudan. The background, therefore, permitted the NBS/AID Survey to add substantially to the benefits that the Sudanese Government might draw from the Winser Report.

IV. The Itinerary

With minor changes the team followed the program laid out by our hosts, under the leadership of Mr. Ahmed Lutfi. As discussed with Mr. Steffen Peiser during his Survey planning visit to Khartoum three months before the Survey, the itinerary included visits to:

1. Governmental Authorities.
2. Industrial Organizations.
3. Food and Drug Industry.
4. Cotton Textiles Industry.

The visits in this report are summarized under the above categories which should not be confused with the subgroups into which the Survey Team was split in order to cover within a two-week period representative samples of organizations covering a country as varied as the Sudan in its culture, its climate, its population, and its products. All subgroups took part in the opening and closing sessions as well as some other visits. Moreover, there was often a grouping of several subgroups into the same visit, and all subgroups took part in some visits in all categories.

The record shows which team members participated in which visits, but this report, for sake of brevity, does not give this detail.

The complexity of the itinerary in itself is an achievement uncommonly attempted in less economically developed regions of the world. It is necessary to record the remarkable success due to Mr. Lutfi, who will look back on this harassing experience as one that introduced his organization to a standard mode of operation which could assist the Sudan in the future since all national standards organizations, to fulfill their function effectively and efficiently, must maintain a most complex pattern of contacts and communications.

IV-1. Visit to Governmental Authorities

IV-1-1. Visit to the Ministry of Industry on February 25 in Khartoum

All team members were present for the initial briefing session. The Sudan was represented by the Survey Director, the Deputy Minister for Industry, the Honorable Sayed Abdel Atif Widaatalia with:

- Dr. Fareed Alraih
- Sayed El Amin El Awad
- Sayed Ahmed Babiker
- Sayed Awad Dafalla
- Hassan Mohi El Din
- Dr. Abdel Gadir Mohd. Abdel Gadir
- Dr. Ibrahim Hassan
- Sayed Tag El Sir Mohd. El Hassan
- Sayed Hassan Kambal
- Sayed Ahmed Mohd. Lutfi
- Sayed Mohd. Nur Mahgoub
- Sayed Zakria Abdel Nabi
- Sayed Abdel Gadir Suliman
- Sayed Jozeph Zaki Boutros
- Sayed Yousif Zaki

The team members from abroad were:

- Mr. Abdulla Mohamed Fadlalla,
Arab Organization for Standardization
and Metrology (ASMO)
- Mr. Benjamin M. Gutterman, U.S.A.
- Mr. Herudi Kartowisastro, Indonesia
- Mr. Mohamed Benkirane, Morocco
- Mr. Gain L. Louis, U.S.A.
- Mr. H. Steffen Peiser, U.S.A.
- Miss Joan Pring, U.K.
- Dr. Mahmoud Salama, ASMO

° Dr. John K. Taylor, U.S.A.

° Mr. Albert D. Tholen, U.S.A.

During this opening session of the Survey, the team was received by the Minister, the Honorable Dr. Abbadi Bashir.

After opening remarks stressing the NBS/ASMO cooperation and introductions by Mr. Peiser of the foreign team members, the Minister gave a summary of the industrial history of the Sudan and outlined the national development goals--in priority order: for cotton, sugar, leather, oils, building materials, food, fertilizer, pharmaceuticals, and pesticides. The Ministry is responsible for all added value given to agricultural products. Encouragement of the substitution of imported by domestically produced goods is a national policy. The Minister stressed a close partnership between the public and private sectors which have an approximately equal share estimated by ownership of industrial production capacities. The need for standardization and measurement for quality assurance was recognized. The Minister and his Deputy, the Honorable Sayed Abdel Atif Widaatalia, who was appointed Survey Director, welcomed the foreign team with great warmth and considerable expectation of benefit to the country.

IV-1-2. Visit to the Ministry of Commerce, Quality Control Section, on March 1 in Khartoum North

The team was received at the Ministry of Commerce by Mr. Mohammed Osman Hanufi, Head of Department, responsible for the implementation of the Produce Inspection Act 1972. Under this laboratory, training is also undertaken. One activity, in Port Sudan, deals mainly with the issuance of certificates for shipment of goods for export. Another, in El Awad, is in the production area for groundnuts with the idea of controlling quality before the product is moved to port for shipment. An inspection system in the production areas is also operative.

The Department concentrates on grading seed products: groundnuts, sesame seeds, cotton seeds, castor seeds, undecorticated cotton seed cake, decorticated groundnut cake, and sesame seed cake (but not oils). Work is primarily directed to improving quality of exports. Shipments by Sudanese regulations have to be covered by certificates. The customs service issues the certification to make sure that it is always in order. Incentives for quality are said to be provided by establishing guaranteed prices, set by the Minister of Commerce. They apply in the auction market.

Laboratories carry out analyses to buyers' specifications, if required, or issue certificates in accordance with contracts between local suppliers and their buying agents. Each laboratory sample was stated to be 1 kg. It was estimated that some 600-700 samples were analyzed a year. A guess was made of the rejection rate at 2-5 percent.

Mr. Hanufi stated that since 1972, when disputes and quality discounts cost S\$10 million a year (US\$25 million), quality had improved significantly. Inspection is of processes, e.g., removal of foreign matter from sesame seeds, and does not relate directly to improving the results obtained from laboratory analyses. The extension services of the Ministry of Agriculture are also involved in production control, e.g., crop protection. Aflatoxin hazards were discussed, especially as there might be a storage delay of up to 2 months in the humid conditions of Port Sudan. There was some lack of certainty about what happened to rejects. Rejected groundnuts were said to be reprocessed and not diverted to the local market. We were informed that reprocessing is attempted by removal of moldy portions or by pressing out the oil and destroying the cake. The Tropical Products Institute procedure is used for detecting aflatoxin, as well as the American toximeters for monitoring. However, these are inadequate and it is believed that more up-to-date and accurate methodology should be adopted to provide greater safety to consumers.

The group did not examine any specifications or methods of analysis. The Department of Standardization and Quality Control (DSQC) has produced Arab Organization for Standardization and Metrology (ASMO) standards for groundnut seeds and sesame seeds. Draft standards are on hand for cotton seed cake, sesame cake, and groundnut cake.

The reported reduction of losses due to disputes and discounts is evidence of the effectiveness of the quality control laboratories. Further inquiries about the fate of rejected products should be made. There might be potential for improving the linkage between the inspection with the specification eventually used for certifying conformity.

IV-1-3: Visit to the Office of Weights and Measures of the Ministry of Trade and Supply on February 28 in Khartoum North; and Medani on March 2, 5, and 8

The team members were received in the Office of Weights and Measures by the Director, Mr. Ahmed Mohamed Babiker, his Deputy, Babiker Abulhassan, and the officer in charge of training, Mr. Mohamed Yagoub Abdella.

The mission of the organization is to provide equity in the marketplace. The team was given a briefing on the organization, operations, and goals of the Sudanese weights and measures activities by visiting the central weights and measures offices and workshops preliminary to visiting Omdurman and other (provincial) weights and measures offices.

Mr. Babiker's offices house "the Sudan Standards"; the "Primary Standards"; the "Standard Copies"; the Weights and Measures Workshop; and training facilities.

Modern weights and measures activities were started by the British and are traceable to the British "Department of Prices and Consumer Protection; Standards, Weights and Measures Division." The hierarchy of standards in the Sudan ties to the British through the Class B standards of the kilogram, meter, and liter (the Sudan Standards) and to the Sudanese marketplace through the Primary Standards, Standard Copies, Area Standards (Provinces), and Working Standards.

Permissive standards (non-metric working standards) are being phased out gradually--although complete elimination is far off. The standards are sent to the United Kingdom every five years and a certificate is issued by the United Kingdom Calibration Service now at the National Physical Laboratory. It is recommended that the Sudan seek to become a signatory of the Treaty of the Meter.

Weights and measures activities in the Sudan are organized into: national offices including the workshops which support the entire country; the Khartoum weights and measures office (1 inspector and 1 assistant); the North Khartoum office (1 + 1); the Omdurman Office (1 + 1); 18 provincial offices (each 1 + 1). The entire country has 22 inspectors plus 22 assistant inspectors.

The workshops are responsible for the maintenance and repair of government measurement devices and reference standards. The total workshop staff consists of 13 members, with three 3/4-ton trucks. All areas of the Sudan are visited as required. Major repairs are made in the shops in Khartoum North which also handle the installation of large scales (e.g., for livestock) throughout the country. The workshops, to do the work projected in support of national development, would need a staff of 50, a stock of spare parts, and better means of transportation.

Headquarters provides training of weights and measures inspectors through a full-time, three-year study program. The prerequisite is completion of secondary school. Training includes: English, physics, measuring principles, and applied weights and measures.

New devices entering the Sudan must be submitted to the National Weights and Measures for type approval examination. If the device is approved, a certificate is prepared and sent to all provincial offices. New, certified devices introduced for trade in the provinces are inspected by the province inspectors and, if they meet the criteria, are stamped individually for use in trade. It is illegal to use a non-stamped device in commerce.

The area (provincial) standards are examined by comparison with the national standards every 5 years and a certificate is subsequently issued. The largest single weight used is 50 kg.

Prepackaged commodities are subject to net weight examination. However, many commodities do not contain contents identification on the label relating to constituents and weight. Examination, therefore, is very infrequent and non-uniform.

In discussing long-range plans for Sudanese weights and measures activities, a Sudanese handout was used (see Appendix A) describing plans for:

1. Assaying and hallmarking.
2. Training.
3. Expansion of services.
4. Metrication.
5. Weights and measures standards calibration laboratory.

The team promised to provide the Director of the Sudanese Office of Weights and Measures with:

1. The floor plan of a typical U.S. State metrology facility.
2. The listing of State standards.
3. The international definitions of standards hierarchy.

Observations:

1. The assaying and hallmarking plan is well underway. Most of the needed equipment has been obtained and recruiting of staff is proceeding. Ultimately, a staff of 25 will be developed (with 80 percent of the effort in the Khartoum/Omdurman area). The Egyptian hallmarking service is being used as a model which appears to be appropriate for the needs of the Sudan.
2. The training plan reflects the aspiration of Sudan to becoming a center for the Arab region and calls for a training institute. This plan appears to be optimistic since they have at present some difficulty in providing funds for training to satisfy Sudan's own immediate needs.

3. The plan for the expansion of services calls for the establishment of 8 additional weights and measures activities in the provinces (additional to 2 new offices recently established). The plans are detailed including associated budget increases necessary. Funding must be provided in the budgets of the province commissioners. The need for large mass calibration and certification activities are recognized for support of import/export trade and movement within the country. Adding new capabilities to handle larger capacity scales plus in-motion-weighing facilities for bulk commodities is essential for such new services.
4. Plans for metrication aim at gradually eliminating the use of non-metric units and standards. The general plan is to use SI units. An overall long-range plan has been developed and submitted but not approved so far.
5. Plans for a weights and measures calibration laboratory were made to replace the current brass standards with platinum-iridium standards. The team advised against this plan because it failed to provide any benefit in the absence of a high accuracy method for intercomparing weights of widely differing density.

Sudan does need precise weighing devices such as a good kilogram and a good 50 kg balance. The domestic and visiting teams favored plans to strengthen facilities that fulfilled practical needs as opposed to concentrating on facilities which would only add to a prestigious image.

At the Office of Weights and Measures for Gezira Province in Wad Medani, the team was received by Mr. Saad Ali Abdul, Chief Inspector for Gezira Province, where he is responsible for enforcement of Sudanese weights and measures law and regulations. Mr. Babiker explained that Mr. Saad Ali Abdul had served in many other provinces and was the most experienced of the provincial inspectors.

The team saw the provincial office, its equipment and facilities, and interviewed Mr. Saad Ali Abdul. The display of weights and the workshop were of special interest. Mr. Tholen agreed to provide literature on new devices such as electronic scales.

The office is composed of 4 rooms--a reception room with 150 sq. ft., the office of the chief with 150 sq. ft., a display room of 240 sq. ft., and a storeroom combined with workshop facilities of 340 sq. ft. The

staff consists of the chief inspector, an assistant inspector, a clerk, a typist, and a driver. The office has one pickup truck 16 years old.

Each provincial office has a set of "area standards" plus a set of working standards. They can check scales up to 500 kg. Any scales above this must be checked by load substitution. Area standards are sent to Khartoum every 5 years; working standards are checked against area standards at least once each 6 months.

The following problems were discussed:

1. Testing of large scales (e.g., 40 ton at a sugar factory) requires weights larger than are available.
2. Electronic (load cell) digital devices introduce new technologies for which there is no experience, training, or even literature in the provinces.
3. Limited transportation with only one 16-year-old pickup truck which also presents a maintenance problem.
4. In-motion weighing, especially for bulk commodities, require new and special training and equipment.
5. The shortage of inspectors limits the work to the most pressing requirements.

IV-1-4. Visit to the Industrial Research and Consultancy Institute of the Ministry of Industry on February 25, 26, and March 5 in Khartoum.

At the Industrial Research and Consultancy Institute (IRCI), the team was received by the Director, Dr. A. B. Husein, and most of his senior staff. Dr. Husein has his doctorate from the University of Minnesota. The mission of the Institute is to conduct industrial research and development, to provide consultation services to industries on a partially reimbursable basis, and to develop methodology for industrial measurements. It was established in 1965 as a joint undertaking with UNIDO. Since 1975 it has been entirely Sudanese. There are departments of documentation, economic analysis, industrial management, laboratories, and one department has the title of Standards, Testing, and Quality Control. Work is in: textiles, food, building materials, domestic appliances, etc.

The Standards, Testing, and Quality Control Department deals with formulation and application of standards, applied research and development, training, quality control, testing and certification, and pre-shipment inspection for export.

The team saw the office, library, and selected laboratories. The staff performs evaluation work, economic surveys, engineering feasibility studies, and actual laboratory scale experiments. They are well equipped to develop specifications and set up quality control procedures, except for work for the food industry. The institute has a staff of 250; 50 Ph.D.s, 25 M.S.s, 100 B.S.s, the remainder are technicians. They feel that specifications, sampling, and quality control are all part of a package that must be integrated. They have a statistical group to provide support which is a very important factor. They do educational work and publish a magazine, "Industrial Output", as well as pamphlets. They regard standardization as a broader field than specifications. The members of the foreign visiting team agree with this viewpoint. It is a problem area involving sampling, quality control, feedback, and correction processes.

A need is felt in the Sudan for a capability to develop pilot plants. Most work on processes has to start at the bench level, for which they are adequately equipped; but they lack facilities for the next stage, the pilot plants. Sometimes they are forced to test ideas on the full plant scale. They believe that a central pilot plant laboratory is a national need and they would like to establish a national facility. Priorities for such plants are for the paper, textile, and chemical industries.

They feel there is need for regulations (legal), but consumer education is a big factor to create a demand for quality. More voluntary standards should be generated by trade groups, etc., with a good balance of representatives from producers, users, and general interest groups (similar to the mode of operation in ASTM).

Dr. Sayed Zakria Abdel Nabi, the chief of the Standards, Testing and Quality Control Department, outlined his department's work (a descriptive report written by him and his staff is available). He has a well-qualified, well-paid, well-motivated staff of 31; 190 items of different laboratory test equipment are distributed between 2 sections for: (a) mechanical and physical testing and (b) analytical chemical testing. The available space is inadequate and will soon be replaced by new facilities. This department within IRCI appears to complement the separate and younger organization of the Department of Standardization and Quality Control. Some are impressed by considerable evidence that this department within IRCI is better qualified than the Department of Standardization and Quality Control to be the national standards body. Regret was expressed at early work on preparing standards not being retained under the present scheme. However, a continuing role in consultancy and the application of standards through existing test facilities was desired. Cooperation in government procurement was another important function which would receive concentrated effort.

The visiting team formed the strong impression that a fruitful cooperation with the Department of Standardization and Quality Control could develop. The Department of Standardization and Quality Control could fulfill the institutional role of a national standards body, organizing technical standards committees, administering the national standards corpus, and providing the international interface; while the IRCI Department provides a practical supporting service in the application of standards. It would also contribute feedback to DSQC from its experience of industrial problems and the results of its research. Specialists on its staff could be key members of the Committees of DSQC. Parallel organizational divisions of responsibilities operate satisfactorily in several countries, as for instance, in Great Britain. In the United States, these functions are further subdivided among many organizations with some overlap and even some rivalry.

The Institute ~~will soon~~ set up a national central instrument repair, calibration, and maintenance center in cooperation with the National Council for Research (see IV-1-8). Because of the problem of spare parts, they may need to make some locally or stock a supply.

The chemical laboratory is recognized as in need of strengthening. The equipment is mostly 10-15 years old; much of it was bought in 1965 when IRCI was established. Much of it is now obsolete.

The Sudan has very few technical professional societies, but the need exists. Leadership could come from this Institute which has a prime position in the industrial technical community.

Training programs as part of the College of Technology and courses for technicians were discussed. Dr. Salama suggested that the present system of taking students for on-the-job training with whatever work was coming in would be more useful if some statement or certificate was provided to show future employers what type of laboratory techniques had been taught. Financial aspects were discussed, especially incentive payments for evening work on jobs which were partially funded out of fees.

The textile laboratory is well equipped for all the common fiber, yarn, and fabric property tests. The person in charge of the laboratory seemed to be well qualified. The periodicals in textile-related fields are adequate but could be supplemented to cover more areas.

IV-1-5. Visit to the Chemical Laboratory of the Ministry of Health on February 27 in Khartoum

At the Ministry of Health, the team was received by Professor Abdel Hamid Ibrahim, Director and also the Government Analyst, and Sayed Jozeph Zaki Boutros, the Deputy Director.

The Minister of Health has been assigned the task of implementing the Food Control Act of 1973. This function is delegated to the "Chemical Laboratory." The Director also operates the Secretariat of the Food Control Advisory Committee, and through an expert committee, registers foods, establishes standards (none so far), compiles a list of acceptable food additives, and provides training, inspection, and analytical services.

The team visited laboratories with facilities to analyze foods, drugs, and water. A "clean" room is used for storage of delicate instruments. Similar facilities are being set up at Port Sudan.

Food standards (none published so far) are drafted by an expert advisory committee recruited from the several ministries with relevant interests and then sent for comment to the industrial sector. Private consumers are not included. A revised draft is prepared. The standards being developed are concerned with adulteration and contamination which may constitute violations because of the health hazard. A food additive list is being developed. Food products must be registered before sale. Imported items are examined.

The visiting team made the observation that in the absence of legal rules and standards, there is the potential for unequal administration. However, it is noteworthy that since the Act was enacted no charges have been brought in courts of law.

The laboratories conduct a full range of analyses, including those on drugs and pesticides. Cosmetics are not examined. Pesticides are studied by radiation tracer methods. Water analyses are carried out in accordance with the American Public Health Association (APHA) methods. The Food Control Law (copy available), the food additive, and general food hygiene regulations appear acceptable, but the team received the impression of a lack of adequate implementation.

In further conversation, it appeared that registration of prepacked foods is preferred at this time because it would take too long to cover all items by standards. For registration a producer has to provide specifications and analytical data, products may be tested, and his factory inspected. Importers have to provide information that has to be particularly thorough because it is not so easy to check up on the manufacturing conditions. The laboratory staff looks for contaminations and deleterious additives. This applies to all goods, but primarily to imported items. Drugs are examined, often by procedures set out in the Pharmacopeia of the United States or other countries. On other occasions they use a company's own specifications. Foreign producers have no rights and can simply be turned down. Such a system has been discarded in some other countries because of its potential for corruption. Training of technicians after secondary schooling is for 3 years. The intake is 20 per year.

IV-1-6. Visit to the Department of Occupational Health in the Ministry of Health on March 6 in Khartoum

Mr. B. M. Gutterman was received by Mr. Mohd. El Hassan Salih, Assistant Director, and Mr. Yousif El Haimi, Industrial Hygienist. The mission of the Department of Occupational Health is to investigate environmental hazards to health and recommend to the Department of Labor any action to be taken. It also investigates plans of proposed new factories or changes to old ones and makes appropriate recommendations.

The purpose of the visit was to determine whether there are effective safety standards and whether they are implemented. The Department of Labor is actually responsible for environmental health under the Safety Act of 1975 in effect since 1977. The office of the Department of Occupational Health makes "scientific" investigations of complaints and makes appropriate recommendations to the Department of Labor. Generally, all recommendations are accepted. Before a new manufacturing facility may be built, the plans are reviewed by the office and recommendations are made. All workers are examined to determine whether their health is adequate for the job.

The Occupational Health Office uses standards of ISO, WHO, etc. This office is primarily concerned with industrial hygiene and environmental safety. Although it has no regulatory authority, its reputation is sufficient for the Department of Labor to accept its recommendations. The Department of Labor has the necessary regulatory authority. For that matter, industry often will accept the recommendation directly. The team could not determine whether national occupational safety standards exist in the Sudan. If they exist, compliance with them is not widely practiced.

IV-1-7. Visit to the University of Khartoum on March 5

At the Engineering Faculty of the University of Khartoum (U.K.), the team was received by Dr. Nabeel Radi Elias and Dr. Alkahman, Lecturers in the Mechanical Engineering Department. The purpose of the visit was to ascertain relationships between academic course work and needs of industry for trained engineers with industrial metrology capabilities. U.K. students in engineering can take a course in production metrology. The team inspected facilities of the engineering metrology laboratories. Here may be the seed to a possible program that with Governmental support could make an effective contribution by training students in measurement science and technology. A widespread understanding of this subject is seen as a key to development in the Sudan.

Faculty members are endeavoring to provide quality training and to produce graduates with relevant capabilities. They are, however,

frustrated because of lack of funding, especially for laboratory equipment. They rightly admit that the equipment is obsolete or of questionable value.

The team noted the following observations made by our hosts concerning needs of industry:

1. There is as yet an inadequate supply of trained engineers in Sudanese industry.
2. U.K. graduates prefer and do go into government jobs where further study is more easily possible, and where graduates are better appreciated, than in industry.
3. Training for industrial jobs is very difficult.
4. Industry is pragmatic in wanting results which often depend on a combination of education and experience.
5. Lack of technician training often results in much damage to equipment, machinery, spare parts and finished products.
6. Industry tends to hire from abroad.
7. Industry in Sudan is not accustomed to employing U.K. graduates who expect more prestigious treatment than they receive.

The "Mechanics of Machines" laboratory course aims to train students in:

1. Fundamentals of mechanics.
2. Techniques of machinery operation and control.

Training is very basic and does not provide for the more sophisticated needs of industry. For example, no laboratory equipment is available for measuring surface roughness or for the precise measurement of internal diameters. In the teaching, SI units are used.

The faculty is very limited; it is extremely difficult to hire instructors, professionals, and departmental heads from abroad. Locally trained graduates are not qualified for the expectations and needs of the Sudan; additional study abroad is essential.

At this time the U.K. does not have, but it is planning to establish, an "Industrial and Production Engineering Department." Money is

budgeted, but the recruitment of a dean and faculty will be extremely difficult. The U.K. has no course work for computer science, operations research, or systems analysis. A computer is available in the Economics Department for support services. Some students use these services in groups.

The team was not really expected in the Faculty of Science but met with Dr. J. Prostejovsky of Czechoslovakia, lecturer in the Physics Department, who with expressed modesty did not wish to discuss the relation between academic training and the needs of industry in the Sudan. He showed the physics laboratory for teaching and briefly described the fourth-year physics course (approximating to classical freshmen physics courses in Britain and the United States). The absent head of the department, Professor Zacharia el Hag Ali, would have been able to discuss the wider issues. The teaching at this university provides the groundwork for more advanced studies abroad.

In summary, it should be well understood that the U.K. is a university with a fine reputation. Its buildings are most attractive. Among the graduates of the science faculty are professionals of high standing, such as Sayed. Ahmed Babiker, who accompanied the team and who, following further studies in Britain, has attained excellence in his field.

IV-1-8. Visit to the National Council for Research on February 27 in Khartoum

At the National Council for Research, the team was received by the President, Sayed Wadi Habashi, the Secretary General, Professor Mohamed Osman Khior, and the Director of the Council for Scientific and Technological Research, Sayed Abdel Rahman Ahmed El Agib.

The Secretary General outlined the role and structure of the Council as the highest and most general policy level organization guiding and advising on all aspects of science and technology. He answered questions about the identification, approval, and handling of research projects. Priorities are defined in the Six-Year Plan and by the Ministry of Planning, to whom the Council may make recommendations. One such example calls for mixing of planned agriculture with pastures in traditional grazing grounds.

Training programs have suffered some setbacks. In manpower, the main shortage is for technicians. Librarians and information specialists are also badly needed. For example, a long delay was experienced in hiring a head for the new Documentation Center. Unemployment is practically non-existent in these specialized fields.

One criterion for research is: problems should be identified that relate to Sudanese environment. Examples of topics are: the effect of Nile flies on chickens that run about excessively to avoid them and the cost-effectiveness of airconditioning related to productivity. More basic research can be done elsewhere. Universities have a free hand but are encouraged to orient work towards national needs. In association with the Industrial Research and Consultancy Institute of the Ministry of Industry (see IV-1-4), the Council is attempting to deal with the urgent and severe problem of instrument installation, maintenance, repair, calibration, and replacement parts.

The Council has a department to interface with UNIDO and UNESCO. Uncertainty was expressed on what this Survey Team had to add to the Winser Report. Task forces were at work on standards to consider Winser's recommendations.

IV-1-9. Visit to the Port Sudan Port Authority on March 3 and 4 at Port Sudan

The team was accompanied to Port Sudan by Deputy Commissioner of the Red Sea Province, Hassan Mohi El Din, and Director General for Standardization and Quality Control, Sayed Abdel Gadir Suliman, and received by Captain Hassan Mohamed Salih, Director of Marine Services of the Port Authority.

The Port Authority of the only major port of Sudan provides pilot service through the reefs and into the natural harbor and allocates entry to berths, unloading facilities, and warehouse, and storage areas, as well as labor for unloading into these facilities. Close cooperation with the customs services is provided.

The purpose of the visit was to observe standards in handling and procedures. The team had an extensive tour of the harbor on a pilot boat. The team also toured docks, warehouses, and open storage areas.

Sudan has focused realistically on the problem of its port facilities. A new modern port is under construction at modern Sawakin nearby and 8 km north of the ancient port of Sawakin, which was also visited. As a short-term measure, the Port of Sudan has greatly improved its capabilities though it is limited to a 31 1/2-foot draft for freighters (up to 12,000 tons) and a 40-foot for oil tankers (up to 40,000 tons). There is a direct pipeline to the nearby oil refinery (see IV-2-6). One hundred thirty ships can now be handled per month with a 24-hour docking capability. Repair facilities are limited to 7,000-ton ships; only very small ships can be handled on the slipway. Only 2 cruise ships a year are expected. The daily tide is only 1/2 inch but 3-foot differences in the Red Sea level are experienced over a year. Active boatyards manufacture very small craft. The harbor is open to all flags except that of Israel. With the widening of the Suez Canal, more shipping is expected.

Unskilled labor receives wages of about \$5 per day. Some piecework opportunities are provided. The major problems of the harbor authority are warehouse and storage space, handling and locating of cargo, and transporting it from the harbor. The oil pipeline to Khartoum will bring relief to the overloaded railroad facilities. The surfaced road, when it opens within the year, will make a much larger volume of truck traffic to Khartoum possible. Present driving time, mostly through the desert, is five days.

IV-1-10. Visit to the Ministry of Industry on March 9, 1978 in Khartoum

All team members were present for the closing session of the Survey at the Ministry of Industry. The team was received by the Director of the Survey, the Deputy Minister, Sayed. Abdel Atif Widaatalia. The purpose of the visit was the formal closing session of the Survey.

Mr. Peiser compared the Survey with the mode of operation of a technical standards committee. Views had been exchanged in discussions and studies; consensus had been reached on most issues, unanimity on some. He lauded the impressive development of industries in the Sudan and the planning of the Survey. A strong focus on organizations for standardization seemed much needed now. A suitable organization existed in the Department for Standardization and Quality Control. The same applied to the need for an organization concerned with measurements for industry, a function that could continue to fall on the Industrial Research and Consultancy Institute. The Commerce Ministry's Office of Weights and Measures in the legal control of retail markets was in need of additional support. Continued policies encouraging the practice of cooperation between organizations and the technical training of Sudanese nationals would benefit the country greatly. Visits to the United States of Sudanese experts would be welcomed by NBS. However, NBS would not be able to organize this activity unless all other authorities concerned could convey their commitment by September 15. A tentative NBS/AID budget was submitted.

Each subgroup coordinator summarized the views of the five subgroups on food, legal metrology, chemical industry, standards committees and interagency cooperation, and cotton textiles. They are given in more detail and with substantive conclusions in Section V of this report. The meeting ended in cordial exchanges of felicitations and good wishes.

IV-2. Visits to Industrial Organizations

IV-2-1. Visit to the Building Materials Corporation in Khartoum on February 27

The team was received by Mr. Mi el Shoush, the Managing Director.

The Building Materials Corporation develops and operates plants for the production of cement and other building materials. It is 100 percent government owned. Demand for cement is now 600 thousand tons per year, and it will increase to one million tons per year soon. The Company was started in 1970 and at the present time has two cement factories in operation. The team saw the office only, since the plants were not near enough to allow a visit within the schedule.

The plant at Atbara, the Maspic Cement Corporation, has a capacity of 220,000 tons per year and employs 1,000 people. Another plant was built by Yugoslavia but has problems so is now being rebuilt by a German firm.

The Company is considering new products, including a red-brick factory, a precast concrete factory, a quicklime factory, and possibly, a glassmaking facility. However, a question remains about the quality of available sand. Sources of good marble exist in the Sudan and the Company intends to develop this resource. The Industrial Research and Consultancy Institute does the laboratory work for this Company. The Building Research group at the University of Khartoum also works for the Company.

The main problems at Atbara are electric power and transportation of raw materials. The factory is said to be poorly located.

The Company is planning to start its own bag factory unit. A pilot plant study by the Industrial Research Consultancy Institute would be helpful. This statement confirms a strong plea made by IRCI for the means to expand its pilot plant facilities (see IV-1-4). The Company hopes to have spare capacity of cement for export and believes that this aim can be achieved in the near future. The Company uses the BS 12 standard for cement and sees no problem with this. Quality control is not based on the use of instruments but it is said to be satisfactory.

IV-2-2. Visit to the Modern Match Production Company in North Khartoum on February 28

The team was received by Mr. A. Izzelarab Yousif, the Managing Director, and Mr. Abdul Raman Azeez, the Plant Manager, of the Match Production Company. The factory produces all matches for the country and is the sole producer of matches in the Sudan. It is 100 percent privately owned by Khalil Osman and Sheik Salah and is associated with the Gulf International Group. It has a capacity with 1 1/2 shifts to produce all of the country's needs. At full operation, it could export to neighboring countries. The Company has even received requests from the U.K. and others to supply because it can produce a good product cheaply, due to the labor situation.

The team inspected the plant and offices. They have a small laboratory, adequate for only very simple testing. Testing is

essentially concerned with inspection for appearance, count of fill, ability to light, breakage of sticks, etc. The team had a tour of the very modern plant in operation. There were inspectors rejecting boxes of matches for various reasons. Precise statistics were not shown and possibly not kept.

The plant started to produce in 1965. Originally the management tried to use local woods for matches and boxes, but had to give up the attempt for both applications because of the aim to produce a high quality of products in the absence of facilities to do research on locally available woods. Coated paper is used for boxes. One size of match only is manufactured at the present time. Capacity of one shift is 105,000 cartons per year. At this time 1 1/2 shifts are operating, employing 342 workers. It has just installed a new production line that requires only 39 workers per shift as compared with 270 using the old equipment. The Company prides itself on the quality of its product. The aim, for example, is on the average to supply 45 matches per box, while the standard calls for a minimum of only 35. Nevertheless, the management is not completely satisfied with the appearance of their product. Printing is done outside and the printer often causes labels to be misaligned.

As previously implied, more than 80 percent of raw materials are imported, because national wood is either thought to be not good enough or at any rate has not been proved to be adequate. Fiber durability and strength are said to be inferior. The problem of heads snapping off would cause both a hazard and a nuisance. The Sudanese Government would encourage a switch to a local wood if adequate quality could be demonstrated. The firm will soon begin to manufacture book matches and would also like to manufacture matches of a smaller size. There is thought to be a customer demand and production would also be more economical and have other advantages. The present standard is said to be too rigid and detailed. It specifies, for example, the size of the box and the number of boxes per carton. The plant management feels that a change to performance standards would be better. They should have flexibility on the above matters. They are on the Committee of the DSQC but are outvoted 7 to 1. They believe that decisions should be on a technical basis. The Company has problems because 65 percent of its work force is illiterate. These employees are, nevertheless, capable of thinking and learning mechanical operations. With the best of will, however, there are limitations. In Sudan there is a brain drain of technical people. Port handling problems were also considered severe. For example, this Company says it cannot order items weighing more than 1/2 ton due to present handling problems at the port. Misunderstandings with governmental authorities, as in other countries, can also cause problems for industry. Recently, the Supply Ministry thought that there was a shortage of matches and permitted importation of foreign (Chinese) matches of small size which the Ministry does not as yet permit them to make. The Company feels that this is an unfair situation.

IV-2-3. Visit to the Rainbow Paint Company in North Khartoum
on February 28

At the Rainbow Paint Company the team was received by Mr. Kamal Hanna, the Manager (Commercial), Mr. Gaafar el Amin el Bashir, the Technical Manager, and Mr. Abdel Salam Ibrahim Mohed, the Business Manager.

The Company produces a wide variety of paints, industrial mixed solvents, and adhesives. Two-thirds of the products are under license from Imperial Chemical Industries of Great Britain and one-third under their own brand name which is "Rainbow." This 90 percent private-10 percent government-owned company produces exclusively for domestic consumption. It does not export but could do so. All raw materials are imported, but the Company fabricates the cans and prints the labels. The team saw the plant, laboratory, and office. The plant is modern, clean, bright, and appears to be well equipped. The small but modern laboratory is adequate for quality control, which is largely for color, viscosity, and density. The Company uses a good system for formulation following practices recommended by the Imperial Chemical Industries. Raw material control is achieved by buying from reliable suppliers. The laboratory also is adequate for changing formulations for color match based on measurements with foreign equipment. The laboratory does no product evaluation such as weathering characteristics.

It appeared to the visiting team that this Company does not have many problems. The supply of foreign procurement licenses is adequate. By good and probably necessary policy, the Company tries to keep on hand a 9-12 months' inventory of raw materials. Since ingredients used in small amounts can cause problems if delayed, a special effort is needed to explain to the Government's import office the importance of attention to such items. The Company now works according to British Standards. The production manager is a chemist and belongs to the American Color Chemist's Association. We discussed ASTM and we gave him addresses to write for standards. He visited the United States once but did not see paint factories. He believes such a visit would be helpful. A big problem is transportation of raw materials from Port Sudan. Even though a pipeline has just been opened between Port Sudan and Khartoum, the railroad still does not have enough capacity to haul more than a fraction of the freight from Port Sudan; so the Company must rely on trucks. The road is long and still bad in stretches. However, a modern road is to be completed this year. No problems of maintenance and spare parts are experienced. Management seems very alert and proudly claims to keep ahead of problems.

IV-2-4. Visit to the Bittar Company, Ltd., at the Soap and
Allied Industries Division in Khartoum on March 1

The team was received by Mr. Gilbert Brahasha, the Director, and Mr. Raymond Bitar, who described himself as a new employee learning the

business of the Bittar Company which is engaged in the manufacture of cottonseed oil (sometimes peanut oil), laundry soap, toilet soap, detergent powder from imported materials, and glycerin, a by-product of soapmaking.

The purpose of the visit was to observe the level of control and standardization in the plant which was freely shown. It demonstrated good understanding of quality control and use of standards. It is a private sector operation. Egyptian and American type cottonseeds are used. Oil is sold in large tins for institutional use and small units for retail. The gossypol is removed from the cottonseed oil and this is determined by color reduction--low band red 8 for industrial sales and red 5 for retail. Internal and Ministry of Industry approved specifications are used. Acidity is limited to 0.1 percent as oleic. Oil remaining in "press cake" is 5-5.2 percent. Any lower percentage causes difficulties in refining.

Soap production is well controlled. No batch may move from one point to the next until the laboratory approves. Laboratory personnel are trained on the job and periodically checked by the director who is a chemical engineer.

Samples are collected by the Ministry of Industry. Generally the control effort appeared to be sound. However, the control of filling soap powder and detergent into cartons and plastic envelopes was erratic, and it appeared that no corrections were being made. The weighing of 55-gallon drums of oil was less accurate than desirable. Concerning the Lux toilet soaps which Bittar was manufacturing under contract to Unilever, it appeared that the samples of finished products sent to Unilever were sometimes found wanting. These deficiencies and lack of standards or lack of adherence to existing standards could contribute to waste of already limited supplies at the national level.

The Sudanese team members had a very high regard for Mr. Brahasha, the Director, asserting that he is most competent, both technically and managerially, and serves on a number of government committees to establish technical and standardization documents.

IV-2-5. Visit to the Khartoum Tannery at Khartoum on March 1

At the Khartoum Tannery, the team included Dr. Fareed el Rayah Hussein and Mr. Hassan Mohi el Din and was received personally by Mr. Abdel Rahman A. Obeid, General Manager, and members of the staff. The Tannery produces a wide variety of finished leather and pickled hides for both domestic use and export. Varieties include sole leather, upper leather, garment leather, technical leather for industrial belts, etc.; tanned special skins, such as python, leopard, monkey, etc.; upholstery leather, gloves, etc. Discussions took place in the office

followed by a quick tour of the laboratory and plant. Skins are obtained as frame-dried, salted, or even fresh. They are inspected by trained people and graded into 1st, 2nd, or 3rd quality or rejected. The accepted skins are purchased by the kilogram, with the price based on grade. Tannery chemicals are imported, including lime, because the local product is variable in quality and the CaO content is not standardized. There are no specifications for leather, except for army boots. The laboratory does analysis of chemicals used and practices process control for concentrations, pH, etc. There are no physical test facilities but the Company has good cooperation with the Leather Institute located next door. There are numerous small tanneries in the neighborhood that produce leather of variable quality. The latter buy some of the skins rejected by the Khartoum Tannery. This Company produces 90 percent of the leather sold in the country. It also does considerable export of specialty leather, such as kidskin for gloves--the United States is a big customer. The Company uses the chrome and vegetable tanning processes. The Company installed a waste control pond operated on biodegradation, from which the water goes to a sewage treatment plant. The latter uses primary treatment and land disposal of the effluent. The Company disposes of solid waste to a glue factory. It is also used for fuel by brick manufacturers. Management expressed no problem with specifications or standards. If there are any problems, it does not recognize them. Grading of leather is mostly qualitative, consisting of visual inspection, based on long experience. If a low grading is challenged by the vendor, the Company sometimes agrees to process at the vendor's risk. Some customers request tests to prove the degree of penetration of the tannage. The manager said he knew of ASTM and was a member of the British Leather Society. Perhaps inadequacy of local lime is the major problem. This will probably be corrected when plans of the BM Corporation materialize for the the installation of a modern lime plant. Distrust of local materials is the basic reason for importation. It will not be so when good standards practices become fully accepted here.

IV-2-6: Visit to the Port Sudan Refinery at Port Sudan
on March 3

The entire team was received by the British manager of the Port Sudan Refinery. He is an employee of the British Shell group which provides technical and managerial guidance to this Refinery. It is the only refinery in Sudan and meets the needs of the country for gasoline and fuel oil. It manufactures neither lube oil nor bitumen. Shell standards are used, and the Refinery is clearly well managed and looks efficient. It has a good laboratory and does the usual testing. It is quite prepared to do some testing for other organizations and, in fact, is already now doing so on a small scale, but the company's own testing needs would always come first.

The manager stated that output of the plant could be increased by adding parallel units, with little increase in operational staff.

After several years of duty at this Refinery, managers are transferred to other countries. High praise was extended to the dependability of Sudanese operators, but the training had to be done by the refinery and takes several years. The temptation of higher wages has induced some to go to Saudi Arabia. There, however, living costs had risen faster than wages which has caused one or two now to return to the Sudan plant. The loss of even one trained operator was serious for the Company.

IV-2-7. Visit to the Genied Sugar Factory, 100 miles Southeast of Khartoum, on March 7

Acting Director General A. Lutfi led the team which included Mr. Mohamed Benkirane, Eng. Herudi Kartowisastro, Mr. H. Steffen Peiser, Miss Joan M. Pring, Dr. Mahmoud Salama, Dr. John K. Taylor, Mr. Albert D. Tholen, and Mr. Benjamin M. Gutterman. This team was received by Mubashar Mohed El Hassan and other senior staff of the Genied Sugar Factory. The mission of the organization is to grow and harvest and from it produce rather pure sugar without a final refining process. The factory is large and meets Sudanese demand, but a much larger refinery is presently being built which will make the Sudan a major exporter by the early eighties.

The Genied plant is Sudanese managed. Top level managers are trained at the Indian Institute of Technology in Kanpur. The quality of the product is a rather pure but only semi-refined sugar. Quality control is based on measurement of polarization and other properties. The color due to residual traces of molasses does not, of course, compete with fully refined sugar. By-products are not at present sold, but the power needs of the factory are almost met by the bagasse. The molasses are discharged into the Blue Nile, which seems wasteful, since it could be used as a base for cattle feed.

Standards and measurements could benefit this plant--as for instance in assurance of correct weight controls and non-destructive maintenance control of drive train of juice extractor rolls. Much innovation and initiative is shown by the workshop management that manufactures, by weld construction, trailers for tractors for cane transportation to the factory. Electric and oxyacetylene welding is carried out with imagination under primitive conditions.

IV-2-8: Visit to United Plastic Industries in Khartoum on March 5

Team members, including Dr. Fareed el Rayah Hussein and Mr. Hassan Mohi el Din, were received by Mr. Nageeb G. Kronfli, the Production Manager of United Plastics Industries, which produce plastic pipes and coated wire for telephone circuits and low current conductors. They also extrude shapes such as cups, chair-leg caps, and plastic cord for chairs, and manufacture plastic film and bag stock.

United Plastics Industries have reasonably modern extrusion equipment. They can produce tubing for water piping from 1/2--4 inches in diameter. Government is their biggest customer for tubing, and the military purchase supplies of wire. They work to British Standard BS 5130 (1974) for their tubing. All raw materials are bought abroad as pellets from Japan, Singapore, Italy, Lebanon, etc. They have the usual delays at Port Sudan, so they elect to use truck transport. Pricewise, they find it hard to compete, possibly due to "dumping" policies of some foreign manufacturers. Local production of raw materials would help. For example, they buy theirs as pellets or chips which is the most expensive form. They would like to set up a pelletizing plant and then would only import the resins. This would cut costs considerably, but they cannot get a license to build such a plant at the present time. The team was inclined to believe that a carefully prepared study would show such a plant to be cost effective.

The company has no laboratory but does some "on-line" physical testing, such as the bursting strength of tubing, thickness of film, etc., but this testing appears to be haphazard and could hardly be called quality control. Dr. Taylor recommended that they should do more testing. Our host agreed but said they had a good product, no complaints, so it was not really necessary. A study might show that losses due to failure occurs without a system to lodge or receive complaints.

IV-2-9: Visit to the International Perfume and Toilet Industries Company in Khartoum on March 6

Dr. Faried el Ravah Hussein and Mr. Hassan Mohi el Din accompanied Mr. John K. Taylor and Mr. H. Steffen Peiser to the International Perfume and Toilet Industries Company. We were received by Mr. Khalid El Bedry, the technical manager and Mr. Mohamed Suliman Saleh Khider, the Deputy General Manager.

The Company produces perfumes and toilet products, under license from British and French companies. Technical advice is also obtained from the licensors. The Company buys essential oils, bottles, packages, and labels under the licenses so that the products are identical with the foreign brands.

The team engaged in discussion in the office, took a look at the small laboratory, and toured the plant which was temporarily operating far below capacity because of lack of supplies resulting from government-enforced import limitation. The production sequence was described. The Company imports all raw materials except alcohol and water. Imports are under a general license but quantities must be approved and are often restricted by the Government of Sudan. The factory has a staff of 45 regular and about 80 temporary employees. The Company's products are very popular. The pressure of demand is increasing, but because of government import economies, the factory was

operating at 55 percent capacity. Prices are submitted to the Government for review and approval. ²The Company has little or no competition. A modern plant of 4,000 m² is being build in Omdurman and will be ready for production by the end of 1978. There is no guarantee that more raw material will be permitted, and no attempt is being made for domestic substitution for any of the supplies.

No national standards exist for their products. They do quality control on the basis of a few simple tests, e.g., pressure test of every canister of spray perfume which sells for S£2.5 which equals about \$6. They receive visits on occasion from their licensors and send them samples of their product for checking in the home factories. The Company does not know of any problems of a technical nature. They have a franchise for part of Asia and would like to step up the volume so as to export. Their new plant is in recognition of an increasing demand for their products as well as anticipation of some export business. The manager also said they are thinking about a branch plant in one of the other Arab countries.

Their major difficulty is procurement of supplies, especially through Port Sudan. The team is well aware of this problem since it is a recurring one with many manufacturers. However, it should not be overemphasized, because in the next few months and years, this problem is likely to be solved. Apparently, the Government only permits 25 percent prepayment, and long waits at Port Sudan build up high demurrage charges. Railroad transport from Port Sudan to Khartoum may take as long as shipment from Europe. As a result, the Company uses lorries at 4 times the railroad cost. They had a shipment of some vital materials in Port Sudan for 35 days, yet could not get delivery. As a result, the plant had to shut down for a time.

IV-2-10. Visit to the Sudanese Liquid Air Company, Ltd.,
(Private Sector) in Khartoum on March 6

Dr. Fareed el Rayah Hussein and Mr. Hassan Mohi el Din again accompanied Dr. Taylor and Mr. Peiser during their visit to the Sudanese Liquid Air Company. The team was received by Monsieur Paul Gamberlini, the Manager. The Company produces and distributes industrial gases, medical gases, welding equipment, etc. The Company is in partnership with L'Air Liquide, the well-known French Company.

Discussion in the office with the manager and his production manager was followed by a thorough tour around the plant. The Company has an air liquefaction plant to produce nitrogen, oxygen, and some liquid air. Liquid nitrogen is for use by their customers. The Company also produces acetylene from carbide and sells the slaked lime. Customers bring their own containers and have them filled. The Company has a small electrolytic hydrogen generator and produces occasional batches for a limited number of customers. It also sells compressed air. Special gases are obtained from France. An example is nitrous oxide,

which in the Sudan is simply repackaged into smaller cylinders. It sells welding equipment, valves, gas jets, etc., as a sideline. There are no overnment regulations for the gas industry, but the plant follows French practices laid down in AFNOR standards. The Company tests cylinders (hydrostatically) every five years, keeps excellent records on handwritten file cards, and uses the same color codes as are used in France. All special supplies come from France. The safety record is excellent and there seems no cause for concern beyond those normally experienced in this industry.

The Sudanese Liquid Air Company has only limited analytical equipment. There was one gas analyzer. The essential pressure gages and spares were well looked after, but almost no analytical work is done. The Company produces all the industrially used gases for the country. To keep up with a gradually rising demand, it is building a new and larger plant. The present market needs, however, are now satisfied at 45 percent production capacity. Their volume of sales has doubled in the last 2 years, so their new plant for 1980 is based on a continued exponential growth rate of the market.

The only problem, as management sees it, is licensing for imports for spare parts (new valves, etc.). All technical advice is received from L'Air Liquide.

IV-3. Food and Drug Industry

IV-3-1. Visit to the Food Research Center (Agricultural Research Institute, Ministry of Agriculture) in Khartoum North (Village of Shambat) on February 26.

Many team members went to the laboratories and pilot plants of the Food Research Center. They included Dr. Abdel Gadir Moh'd. Abdel Gadir, Sayed Moh'd. Nur Mahgoub, Sayed Hassan Kambal, Sayed Awad Dafalla, Hassan Mohi El Din, Sayed Jozeph Zaki (part time), Sayed Ahmed Babiker, Dr. Ibrahim Hassan, and Sayed El Amin El Awad from the Sudanese side; and Dr. John K. Taylor, Mr. B. M. Gutterman, Mr. Albert Tholen, Mr. Mohamed Benkirane, and Mr. Herudi Kartowisastro from abroad. The team was received by Dr. Babiker Beshir, Director; with Dr. Sit El Mafar Mahgoub Badi, the Head of the Cereal Laboratory; Dr. Abdullah Moniem, the Head of the Bakery Laboratory, and Dr. Abdel Gadir Mohamed Abdel Gadir.

This Food Research Center carries out research, training, and extension work applicable to a great variety of problems under the headings of canning, dehydration, grains, post harvest treatment, oils, microbiology, chemistry, engineering, marketing, and meat. The Center's basic mission is the accomplishment of basic food research for both the public and private sectors. The team's interest was in

the level and goals of metrology and standardization practiced generally in the scientific and technological work carried out there. The team was given the opportunity to see the various laboratories and pilot plants for such products as sorghum (under Dr. Sit El Mafar Mahgoub Badi), the bakery products laboratory (directed by Dr. Abdullah Moniem), the microbiological laboratory (directed by Dr. Abdel Gadir Mohamed Abdel Gadir), and others.

A major ongoing research study is the search for an increase in sorghum flour use and a reduced dependence upon imported wheat. One possibility is to include sorghum flour in bread in proportion to wheat in the ratio of about 40/60 in the finished flour used in bread making. There is an ongoing study of oil extraction of a number of oil seeds. Experimental studies are conducted in the preservation of foods, canning, flour production, and breadmaking, all at pilot plant levels. Other studies concern food drying, concentration, pasteurization, the microbiology of foods during storage, etc. The team suggested that participation in the Association of Official Analytical Chemists (AOAC) by the Center would prove beneficial. In some instances the scientific research effort at the Center appeared to be for the sake of scientific research and not focused on seeking solutions to problems. The team also felt effort would be rewarding to seek out whether problems being faced by the Sudanese had already been resolved by food industry research in other parts of the world. Of course, literature searches are far harder to execute in a country like the Sudan than in a country with extensive information resources. Nevertheless, the team's advice seems valid. For example, the Center appears to be conducting only minimal literature searches on the maintenance of color stability in selected foods, in which topic it is executing an experimental project. Color stability of foods is a universal problem and has been extensively investigated throughout the world. Answers to problems encountered in the Sudan may be available already. Trade journals (e.g., Food Engineering) could also be more widely consulted with advantage because they often list items such as available preservation ingredients.

The centralized pilot plant approach appears to be well integrated into the Center and should be encouraged. The pilot plant for the milling of flours is a good example of well-based studies.

The training portion of the Center appears to be definitely worthwhile, particularly concerning the training of laboratory and production technicians; both are in short supply in the Sudan.

Although we were informed that the analytical efforts of the Center are intended only for the support and use of the Center, the results should be of significant benefit to others. Dissemination of some results may be appreciated.

Whereas this Center is a government function, it appears to overlap some of the efforts of the Industrial Research and Consultancy Institute, a semi-autonomous unit in the service of industry, which is also supported by the Government. Constructive rivalry between such institutions should not be of concern, and seminar or discussion meetings between the groups would help to foster technical cooperation.

IV-3-2. Visit to the Food Industries Corporation (P.O. Box 2341) in Khartoum North, on February 27

Mr. B. M. Gutterman was accompanied here by Sayed Moh'd. Nur Mahgoub, Sayed Hassan Kambal, and Sayed Jozeph Zaki Boutros and was received by Mr. M. Elghali Suleiman, Managing Director, Khicliir Oeman Beshir, Food Technician, and Mr. Mohamed Osman.

The Food Industries Corporation provides management for several public sector food processing firms, including flour mills and those involved with canned and dehydrated foods, dried milk, two "sweets" (candy) factories making "halva" (a sesame seed paste), bonbons, jelly, and custard powder.

Since this was the central management office of public sector food processing firms, the session was simply a discussion at that office. We reviewed the responsibilities of the central management and discussed the products produced, the quality control level, and the absence of national standards. Specifications are developed for products of each plant. There are no exports as yet. Arrangements were made to visit local canning plants which were not on the original agenda (see IV-3-4).

The canning plants managed by the Food Industries Corporation process tomato paste and tomato juice, jams from watermelon and citrus fruits, beans (seeds unknown), okra and mango juice, and eggplant.

The quality control includes a study of the cans both before and after closing the times and temperatures of processing, and the input weights. They use mercury-in-glass and recording thermometers, but mercury is the reference (and this in the opinion of the visiting team is proper). Retorts are checked by a quality control laboratory technician. Records are maintained. The chief of quality control is responsible to the factory manager and not to the production manager (and this, too, in the opinion of the visitors is proper).

Cans are incubated for 48 hours, studied, and then, if acceptable, the lot is released. Can coding is practiced. No national standards are available--each plant establishes its own.

Based upon the information provided, the internal standardization appears to provide a safe product. However, no opinions could be developed by us concerning the quality of the foods produced because

there was a lack of standards against which a check could be made. None of these products are exported yet--all production is for domestic use which could absorb more product than is at present available.

IV-3-3. Visit to Sudan Oil Mills
in North Khartoum on February 28

The team was received by Mr. Bobeker Osman, Factory Manager, and staff.

The Sudan Oil Mills produce vegetable oil, shortening, laundry soap, carbolic soap, and cake from cottonseed. They also do some processing of groundnuts. This is a government-owned, nationalized company. We were given a description of the Mill and then taken on a conducted tour of the plant. There was no harvest of seed at that time, so the plant was not operating but undergoing maintenance repairs.

The plant employs 500 people and has a nominal capacity of 150 tons per day. It is usually operated at a throughput of up to 120 tons per day because of the age of the plant. At times it is operated at one-third capacity because of shortage of seed which comes by truck from Gezira.

Oil content, moisture, protein, color, fatty acids, and some other characteristics of oil, such as iodine number, oxidation number, etc., are routinely measured. The laboratory is inadequate but a new laboratory is being built. It is to be shared by two sister companies--African Oil Mills and the Sudan Soap and Oil Factory. The manager expressed the following problems:

1. The plant is old and in need of renovation. Spare parts are unavailable, so must be made as needed.
2. The plant offers limited process control since no on-stream measurements are made. Often troubles are discovered too late to take corrective action. As a result quality suffers.
3. There is a shortage of trained technicians.
4. Only black seed is used for which no specification is available; therefore, the seed is of variable quality. Often it contains fibers which interfere with the process. The specification on oil is borrowed and not really applicable to the situation in the plant.
5. Procurement of minor laboratory apparatus is difficult. A list was given of needed items such as funnels, filters, bottles, and thermometers. Government permits often reduce the number of items authorized as compared with those requested.

6. Quick tests to control plant operations and quality are lacking.
7. A central procurement mechanism for laboratory supplies seems to be needed by this plant. Such a service could be provided for a group of organizations. The plant has good relations with the Industrial Research and Consultancy Institute, which has helped solve production problems and has made analyses of oil and cake. The new laboratory will also solve some of the problems, but technician shortage will remain as critical as is the procurement of equipment.

IV-3-4. Visit to the Sudanese Paste Canning Company in Khartoum on February 28

Mr. B. M. Gutterman was accompanied by Dr. Abdel Gadir Moh'd. Abdel Gadir, Sayed Moh'd. Nur Mahgoub, Sayed Hassan Kambal, and Sayed Jozeph Zaki Boutros. They were received by Mr. Nahil G. Arafa, the Technical Manager, and Mr. Sabir A. M. Fadl, Director, Quality Control. The Sudanese Paste Canning Company is a public corporation to produce canned tomato paste and both pumpkin (squash) and orange jam. This public sector operation has two private sector competitors.

We visited the cannery and quality control laboratory. Both were not in operation at the time of visit. This operation claims to set its own standards not only for its end product but also for the can-making and canning equipment.

Cans are not coded despite the contrary statement made by the parent Food Industries Corporation (IV-3-2). This would be seen as a serious deficiency in the event a defective lot must be located. For the tomato paste, the target figure for soluble solids is 25 percent \pm 1, (an acceptable level). The jams are lower in fruit content than many standards of other countries would permit. All production is consumed in the domestic market. There is no significant stimulus to upgrade the product since all that is made is sold. At present, the quality control department is responsible to the production manager, but they are intending for him to become responsible to the general manager which, in the opinion of the visiting team, is a better policy.

This Company manufactures its own lids and cans from lacquer-coated steel sheets from Japan. The determination of seam adequacy is rudimentary. Equipment is lacking. Although it was not stated directly, the incidence of "flat sours" (a defect due to faulty closure) is higher than desirable. The can-making and canning practices in this plant could become hazardous to health only if low-acid canned food products were to be introduced without improved quality control and adherence to standards.

IV-3-5. Visit to the Milk Corporation, Kuku, in Khartoum North on February 28, 1978.

The same team as under the previously described visit was received by Mr. Osman Khalifa, the Manager of the Milk Corporation, Kuku, and a staff member in the office of that company. This is a public sector corporation manufacturing full fat fluid whole milk (5.6 percent fat), butter, and skim milk. It has a modern plant, keeping records of temperature and times of the high-temperature, short-time pasteurization procedure, temperatures of coolers, phosphatase (AOAC) tests, etc. It produces 10,000 liters per day. With a gift from Saudi Arabia, the plant is soon to move to 30,000 liters per day.

Milk moves not more than four kilometers from farm to dairy through a collecting point. The dairy receives milk twice a day at ambient temperatures. The afternoon collection is cooled overnight for processing the following morning.

Although record keeping is of a high order, it does not seem that any adjustments or attempts to standardize products are carried out. For example, concerning the quite variable fat content of the packaged milk, one should determine whether there is sufficient benefit derived by standardizing milk fat content so that the batches would not vary as much as they do.

IV-3-6. Visit to The Blue Nile Brewery (P.O. Box 1408) in Khartoum, Sudan, on February 28

The same team was received at the Blue Nile Brewery by Mr. B. M. Bedavi, the Production Manager, and later by Mr. Omer El Zein, Managing Director. This is a public corporation and the only brewery in the Sudan producing beer. It has been a public corporation since it was nationalized at the time independence was won from the British in 1970. The capacity has doubled since then. Although management stated that the plant has a maximum capacity of 250,000 bottles, fewer than 200,000 are produced daily compared with an estimated market potential of 1,000,000 bottles. The quality control laboratory conducts only the most rudimentary tests. The purpose of the visit again was to determine the means of manufacture and the level of standardization achieved. The brewery applies its own standardization and targets. Any variation from the norm is scheduled for correction (if it is not too expensive or time consuming) during the 10 hours of "downtime" each day.

The pressures to produce a greater yield of beer may affect quality. Malt is received from Belgium and France on the basis of bid samples and moved from the Port of Sudan quickly to the plant. All lots of incoming product are fumigated at Port Sudan and again in the brewery warehouses. The incoming products are then examined and about 10 percent of shipments are rejected at the brewery and diverted to

animal feed or destroyed. Mold, insect infestation, moisture, starch, saccharification time, extract color, odor, and diastasis, etc., are determined. The yeast cultures are presently obtained elsewhere, but the aim is to maintain the Brewery's own.

The Brewery management desires appropriate standards for the bottles and caps in order to reduce losses and to upgrade quality. There is a serious problem connected with the bottles and closures. The Brewery is required by the Government to use domestically produced materials. Often the tops of the bottles are not smooth but have two "teats" where the halves of the mold were joined. In addition, many caps are not well laminated with sealing compound. Both these defects cause carbon dioxide to escape during pasteurization. This problem has been partially resolved by having the local cap producer add an extra ring of sealing compound in the cap. Another problem resulting from inadequate bottle closure is the development of an undesirable cloudiness. A good seal inhibits this problem.

The bottles are of different thicknesses, thereby causing the apparent fill to vary by up to two centiliters. Unfilled or partially filled bottles are visually spotted and manually removed from the line. One automatic filler was operating improperly, but there was no time to adjust it during production thereby causing significant production variations and losses. Obtaining replacement equipment parts is most difficult but would be important to making the Brewery more cost effective.

Whereas the production manager is anxious to improve his quality control, the general manager at this time is reluctant to embark on costly changes or improvements that might affect output. He is uncertain of the future for alcoholic beverages in the Sudan. Beer production could be prohibited in the event of passage of an alcohol abolition law that has considerable backing in the country.

Dr. Gadir's laboratory checks samples of the finished products and recommends changes in production controls. The product that was sampled in the meantime will have been distributed and consumed. The products are not coded. Nevertheless, the team recognized favorably the limited commendable controls that are exercised despite the absence of competition and the excess of demand over production.

IV-3-7. Visit to the SAAD Sweets Factory in Khartoum on
March 1

Almost the full Survey Team was received at the Saad Sweets factory, a private corporation producing hard candies, toffee, and halva. The production and packaging facilities were shown. The purpose of the visit again was to observe production and packaging of candies and to understand the use of standards and quality control.

IV-3-8. Visit to the Abdo Rabbo Flour Mills in Port Sudan
on March 4

The full team was received by Sayed Ali Abdul Rabbo, the Manager, and Sayed Izeldin Hamza, Chief Miller. The Abdo Rabbo Flour Mills produce flour from imported wheat, sold to it by the Government at a dictated price, and sell the flour at the price fixed by the Government. The Ministry of Commerce specifies to whom sales are to be made. This mill operates 24 hours per day and shuts down for cleaning one day per month. All production is immediately sold.

The handling of the incoming wheat, cleaning, milling, bagging, and the control laboratories were inspected by the Survey Team. This is a large-capacity operation with much automation. Although insect infestation as well as moisture are measured on incoming wheat, no price differentials are permitted for quality. The finished flour is tested, but again there is no price differential for quality.

The Abdo Rabbo is the second largest of six mills in the country. Although it is in the private sector, its profits are controlled by fixed prices for the incoming wheat and outgoing flour. We were told that there is no special problem with mold and insect infestation, which is accepted as a matter of course. Although 40 - 48°C wheat may be held for 25 days, it is recirculated in the silos.

The wheat for milling is adjusted to 25 percent moisture--sometimes arriving as low as 7 percent and sometimes slightly higher than 25 percent. Very good, clean wheat has about 2 to 3 percent insect infestation. Some of the wheat from the United States has as much as 12 percent contamination. However, the mill is charged the same price.

The finished flour tests are for cleanliness, moisture, and extraction. The last is determined by the bran content in the finished flour. Two types of flour are produced: 86 percent extraction for bread and 72 percent for biscuits. The production was 80 tons of wheat per day in 1972 and was increased to 240 tons in 1974.

Although the Ministry of Commerce checks scales for accuracy, the use of products in international trade provides added impetus to maintain accuracy.

The moisture target for soft wheat is 14 percent and the target for hard wheat is 15 percent. With wheat being received as low as 7 percent moisture, the product is moistened prior to milling. Moisture checks are important and conducted routinely. Protein determinations are not performed. Sayed Amin informed us that only a minority of the industry carries out laboratory checks of ingredients and finished product

The SAAD Sweets Factory is the largest in the Sudan, producing about 90 percent of candy produced within the country. All production is rapidly sold, and demand far exceeds production capability. Therefore, a second factory is under construction in the Khartoum area. The present factory and the new one when completed are labor intensive compared with western candy factories. At least two reasons dictate this:

1. Plenty of unskilled labor and few skilled technicians are needed for operation and maintenance of these plants compared with more automated factories.
2. Difficulty in obtaining and stocking adequate spare parts.

This factory is 27 years old and employs up to 300 workers. It produces 12 different types of candies packaged in plastic, paperboard, and tin containers. Production of the candies averages approximately 27 tons per day and uses 20 tons of sugar. The supply of sugar is at times short and could be an additional temporary problem when the second factory goes into operation.

All candies are packaged by weight. Scales are arranged alongside manned production lines. These balances, bearing the seal of the Weights and Measures Department, are used by the workers to measure the appropriate amounts of candies (depending on package size). The production line is sampled and taken to an inspection station where packages are weighed (total, tare, and contents) and results are entered on a report form. Present tolerances (over and under) are preprinted on these forms. If weight is outside tolerances, the floor supervisor is notified and he takes remedial action after the fact. The noncomplying packages go into distribution. Report forms go to the plant manager in all cases.

In general, the quality of ingredients is not examined. Rather, the factory management depends on the reputation of suppliers. Occasionally, samples are provided to the Ministry of Health for testing.

A form is used by up to three inspectors which rates various aspects of the finished product on a scale ranging from excellent, through acceptable to nonacceptable. Quality measured includes: color, smell, taste, and form of candy; as well as size, printing, color, and appearance of individual wrappings and final container. Completed quality forms go to the plant manager. If the inspector finds qualitative deficiency, he notifies the floor supervisor who takes corrective action. The packaged candies are subject to marketplace check for correct weight by weights and measures inspectors.

IV-3-9. Visit to the El Shiek Oil Company in Port Sudan
on March 4

The entire team was received by Mr. Osman El Shiek, the Manager, and Mr. Paul de Smet, Engineer, of Belgium. The El Shiek Oil Company produces cottonseed and groundnut oil mostly by the solvent extraction process and in accordance with purchasers' specifications. Some oil is produced by pressing of seed. The oil is exported in bulk as crude oil for further refining. The team went on a plant visit and saw the small laboratory.

The plant was built by a Belgian firm but had some initial problems so it is being rebuilt. The old pressing equipment is still in use, but the product is recognized as inferior to the product that is solvent extracted. Paul de Smet (no relation to the firm that built the plant) installed the original plant and is now back to operate it for at least two years. He has a considerable task to train the operatives, but he appears to be succeeding and he does seem to have the confidence of the owners. The firm buys the hexane (the solvent extractant) abroad but achieves good recovery (small loss) for reuse. They have built a standby diesel power plant because of interruptions of electric service. A new steam generator will serve the whole plant. A cleaning plant to clean the groundnuts before entering the plant is being assembled to eliminate dirt, stones, sticks, etc., that now cause wear and erosion. No particular problems are known at the present, but this plant leans heavily on the technical management of Paul de Smet. Sudanese management should be capable of taking over from Mr. de Smet when he leaves.

The Government collects samples of oils intended for export, and if acceptable, a certificate permitting export is issued.

IV-3-10. Visit to the Pharmaceutical Industries Laboratory
in Khartoum on March 5

The team was received by G. Shashati, the General Manager of this private sector "Laboratory" that produces a wide range of pharmaceutical products, some cosmetics, a bug bomb, etc. Some products are under license from British firms, such as Lever Brothers--e.g., toothpaste. They also make Chesebrough Ponds products under license--shampoos, hair tonics, nail polish, hand cream, etc. Some items are manufactured under their own brand. The Government is their biggest customer. The office, laboratory, and plant looked neat, clean, and modern.

The Laboratory can produce all of the common pharmaceuticals such as are made by a druggist. They follow British Pharmacopoeia in general for both formulation and testing. A small laboratory checks products as a pharmacist would. Measurements, such as of viscosity, density, etc., are made. They make ointments, tinctures, and tablets and have

facilities for producing them in quantity, filling, pressing into tablets, etc. For example, a striped toothpaste is made under license. They believe they can make all the common pharmaceuticals with greater precision than a druggist. A list containing 70 common remedies they would like to produce under license was given to Dr. Taylor. Government restrictions are said to be more severe on them than on imported products. The latter are usually taken at face value while the local ones are suspected. Another complaint is that domestic companies must buy alcohol and sugar at retail cost, including taxes, while imports are not taxed.

Our hosts believe that local industry should be given more support. They have succeeded generally in obtaining import licenses for most of the raw materials which are needed, but must often wait four to six months for approval of the needed quantities. They need long-range assurances from the Government so they can establish a line of products that will win sales appeal over imports. They believe there is a jurisdictional problem between the Ministry of Health that regulates them and the Ministry of Industry that encourages industry. This is, of course, a well-known problem alleged to exist in most countries.

Procurement of simple chemicals and laboratory apparatus is a problem for small buyers. There are no local sources--and one can get disheartened processing small orders. Would not a good supply house find a good market in the Sudan?

IV-3-11. Visit to the Karam Biscuit Factory in Omdurman on March 5

Mr. B. M. Gutterman, accompanied by Dr. Abdel Gadir Mohd. Abdel Gadir, Sayed Moh'd. Nur Mahgoub, Sayed Hassan Kambal, and Sayed Jozeph Zaki Boutros, was received by Mr. Abdel Hamed Eddaw, Factory Manager, and El Sheikh Elbugdadi, Technical Manager. The Karam Biscuit Factory is a private sector firm engaged in the manufacture of biscuits, "cream-filled" sandwich cookies, soft crackers, and halva. It is anticipated that this plant will manufacture flour in the future.

The facilities inspected included the manufacturing operation from the receipt of raw materials to the packing of the finished product. This factory, except for packaging and packing, is highly automated. Flour received must be sifted to bring it to a 72 percent extraction from the original 82 to 84 percent extraction. Plans are made to produce flour itself because of the recognition of a need for a low extraction product. The controls are essentially those of experienced bakers who use sensory tests in process and on end products. They do not depend too much upon thermometers even when they are available.

Whereas the management referred to the presence of antioxidants in their imported hardened palm oil, they knew of no antioxidants in the

other shortening. Further, they stated that they know of no other preservatives of any kind in any of the ingredients. There appeared to be only limited information concerning the available raw materials.

There is a frequent shortage of flour and sugar available to the bakery thereby limiting production. They use 45° Baume glucose syrup, dextrose monohydrate, salt, nonfat milk, and citric acid in their biscuits and fillings. There are sometimes complaints of rancidity by consumers.

The lack of available low-extraction flour from a flour mill may cause this bakery to increase its costs of production significantly by in-house milling. With the total yield of the mill intended only for this bakery, costs would be high. A large mill supplying quantities to a number of buyers would be a more efficient operation and, therefore, less expensive.

IV-3-12. Visit to the Flour Mills Corporation at Khartoum on March 5

Mr. B. M. Gutterman, with Dr. Abdel Gadir Mohd. Abdel Gadir, Sayed Moh'd Nur Mahgoub, Sayed Hassan Kambal, and Sayed Jozeph Zaki Boutros, was received by Mr. Farouk El Sheikh El Tom, General Manager, and Mr. Salih Abd Elwahab, Technical Director, both of the Flour Mills Corporation. This is a public sector corporation producing flour for Sudan from both imported and domestic wheat.

The purpose of this visit was to determine the standardization practices of the factory and to share views with our hosts on the need for standards for the future. The team inspected the factory and the laboratory.

Again we found that the Government controlled purchases of wheat at specified quantities and prices, as well as sales of the output of the flour mill. There were frequent production stoppages because of power outages. Power supply on a continuous basis is important, but we were informed no factory in the Khartoum area may install a "backup generator" without government permission which is rarely given. We were informed that installation of backup generators is not permitted unless it can be shown that power outages occur often and that some are continuous for 24 hours or more. The company representatives stated, however, that there are a large number of outages of several hours, followed by a delay of several hours for the factory to come fully "on stream" again.

The mills produce both 86 and 72 percent extraction flour. When more local wheat becomes available, they anticipate lowering the 86 extraction to 80 percent. The production of this mill is 80 percent of capacity. This is governed by wheat availability and power

failures. Although the silos can hold a 3-month supply, the usual storage quantity is only a 2-day supply. Moisture (15 percent) and extraction is checked daily. Insect damage checks are carried out only for wheat from Port Sudan silos. The Ministry of Industry takes samples randomly or on complaint. However, the Ministry's standards are not yet established. The company is represented on the government specifications and standards drafting committees. This company would welcome standards because it is compared with other plants, and if its quality drops, it is probable that it would be charged with seeking excess profits. Most production is of the high-extraction type. The company carries out blending in the event they cannot attain the desired amount of high-extraction product.

We were apprised of an alleged black market operation in that some bakers sell flour instead of bread, and also obtain more than the specified amounts of flour by obtaining it from several sources. They argued that the subsidy does not help the consumer, but instead helps the baker who charges higher prices. It is the opinion of the management that the elimination of subsidies will provide an environment for better competition. Moldy wheat when found is not used but diverted to animal feed. This may be a dangerous practice if the mold is *aspergillus flavus*.

Although the industry is looking forward to composite flours made by blending wheat and sorghum, the price of the latter at this time makes such a composite uneconomical.

All training except for higher positions is carried out locally. Scales are checked by weighing products at other points.

IV-3-13. Visit to the New Industries Co.(s) Ltd. (Pepsi Cola) in Khartoum (P.O. Box 714) on March 6

Mr. B. M. Gutterman was accompanied by Sayed Moh'd. Nur Mahgoub, Sayed Hassan Kambal, and Sayed Jozeph Zaki Boutros and was received by Mr. Strati N. Limnios, Director, who explained that the New Industries Company is in the private sector and supplies the market with soft drinks (carbonated), including Pepsi Cola, Lemon ("Teem" in the United States), and Orange under license from Pepsi Cola, International. The Company also intends to produce strawberry soda from concentrate in the future.

The team inspected the entire bottling plant, which uses only imported bottles because the domestic production is unacceptable. At normal soda water pressures (3.5 to 4.2 atmosphere), a large number of the local bottles explode. Although it has a capacity to produce 1,200 to 1,400 cases per hour, the plant is producing at a rate of only approximately 800 cases per hour. Due to "crown cork" seal problems, the Company rejects approximately 100 cases of bottled product per hour. Present Port Sudan delays of equipment, materials, etc., of 2 months or more affects production and cash flow.

The Company will send Mr. Gutterman a copy of in-plant specifications and control requirements. Carbon dioxide, sugar, and caps are locally supplied. The plant has its own water treatment plant. All products and ingredients are tested. Samples are taken by the plant, by Pepsi Cola International, by the Ministry of Industry, and by the Ministry of Health. The Ministry of Industry is stated to have a soda water standard in effect, but this did not appear to be a part of the system of standards planned by the Ministry of Health.

A chemist is in charge of quality control but is responsible to the production manager. He will soon be made responsible to the general manager.

Because of frequent power outages, the Company has been able to convince the Government of the need for an auxiliary generator.

Sayed Jozeph Zaki Boutros of the Ministry of Health informed us that there have been complaints of fermentation in the product. This may be due to low carbon dioxide, lack of preservative, poor cap seal, poor washing, or other causes. The Ministry of Health has recommended improvements, and we were told that they are being followed. These problems appear to have been concentrated in old equipment and not in recently installed lines. However, the Company may favor the use of preservatives as an added safety feature. Any laboratory reports (plant or government) are usually too late to correct products which are tested. Normally they are sold long before the test results of the samples are received.

IV-3-14: Visit to the Sphinx Macaroni Factory in Khartoum
(P.O. Box 131) on March 6

Mr. B. M. Gutterman, with Sayed Moh'd. Nur Mahgoub, Sayed Hassan Kambal, and Sayed Jozeph Zaki Boutros, was received by Mr. T. S. Calidakis, Manager, and Mr. Mahomed A. Abdelmapeed Abdelmoneim, partners of the Sphinx Macaroni Factory which is a private sector company producing pasta products. All that is manufactured is sold. There is some export to Chad, but transportation to Port Sudan for export to other countries has met with difficulties. The team was invited to inspect the manufacturing facilities, including the receiving procedures for raw materials and packaging of the finished product.

Whereas this company could produce 18 forms (shapes and sizes) of pasta and sell them without difficulties, it produces only 5 because of shortage of flour. Management says that its product is prepared from soft wheat flour, but semolina from hard durum wheat makes a more acceptable product. The former makes a soggy product. Drying requires control; if too fast, the product is brittle; whereas, if too slow, it becomes moldy. There appeared to be few observations made of times and temperatures. No laboratory testing of ingredients or end products is performed.

This plant is singularly lacking in controls, although its practice of the "art" of pasta manufacturing appears to be producing pasta acceptable to the market. The process is semi-automatic, except for packaging which is all manual. The manager told us that he gives away an excess of 10 g for every 400-g package. However, based upon what we saw, we do not see how he can determine that. The scales are old and dilapidated, and the weighing practices are poor. The team observed some birds in the processing, drying, packing, and storage areas. This condition, if not remedied, may lead to health hazards.

The manager desires standards, provided they are directed to Sudan's needs. Further, he believes that any standards should be mandatory, since competitors would take unfair advantage if standards were voluntary.

New lines are to be installed which will be more automated and provide greater output. At this time, with a 2-ton capacity, he produces only 1 to 1 1/2 tons per day due to a shortage of the necessary 72 percent extraction flour.

IV-3-15. Visit to Union Carbide in Khartoum on
March 6

Almost the full team was received by Mr. Herzog and staff. Union Carbide manufactures in the Sudan only one product, namely D-size dry batteries, to U.S. company standards. The team was welcome to inspect all facilities including the very modern plant and control laboratories. Union Carbide is the only U.S. company manufacturing in the Sudan. The parent company operates in 30 countries. The Sudanese plant has been on stream for 2 years with just 7 expatriates achieving productivity and quality standards. The management finds Sudanese labor, technicians, and management trainees excellent. The general atmosphere gives the impression of being purposeful and optimistic, but with needed work discipline. Placed in one of the highest management positions is a Kenyan who experienced the earlier development of a similar plant in Kenya. So far no Sudanese are in top management positions.

Standards are laid down from Cleveland, Ohio. Even raw material suppliers have to be approved and are subject to control checks. There are 17 presently approved raw material suppliers. Only paper products and plastic bags are Sudanese.

The Sudanese demand for size D batteries does not exceed the supply and the firm exports to Jordan. Sale and distribution to retailers is carried out by the company.

IV-3-16. Visit to the Agricultural Research Corporation (ARC)
(Gezira Research Station) in Medani on March 8

Sayed Ahmed Babikr and Sayed El Amin El Awad led Mr. Herudi Kartowisastro, Mr. Mohamed Benkirane, Mr. Albert D. Tholen, and Mr. H. Steffen Peiser. The party was received by Dr. Nasr Eldin Sharaf Eldin, Division Head for Entomology, and Mr. S. I. Shaaban. The Agricultural Research Corporation carries out research in soils, agronomy and crop physiology, phyto-pathology, weed control, entomology, cotton breeding, crop introduction and improvement, and general horticulture. The purpose of the visit was to view this important large research station in a beautiful setting and to comprehend needs for measurement support, standard reference materials, etc. It also seemed most desirable to comprehend how the Sudan had solved the problem of giving some considerable independence to a research organization by establishing it as a Corporation, while the Ministry of Agriculture, Nutrition, and Natural Resources maintained fiscal control and the focus on national needs. Until 1967 this autonomous Corporation now headquartered here was a Division of the Department of Agriculture. Other agricultural research stations of the Corporation are located in the northern and southern provinces. Altogether the staff of ARC includes 150 specialists with degrees--85 of whom hold higher degrees.

The team visit was not expected due to misunderstandings; consequently, we saw the central campus in general and chemical laboratories using latest gas chromatographic techniques for measuring pesticide residues. We were, however, given a general overview description of pesticide research for crops. No work is undertaken for animal husbandry. Work on insect pathogens, sterilization by radiation, and sex hormones is either starting or being considered.

The importance of cotton to Sudan is well reflected in the programs of ARC. Efforts in developing varieties resistant to black arm and leaf curl have been very successful. The importance of sorghum, wheat beans, and sugar cane research is rising. No information appeared to be available on human allergies from contact with castor beans.

The mission of ARC appeared to be understood and fulfilled by the staff, and the research atmosphere seemed very good and confident.

IV-4. Visits to Cotton Textiles Industry

IV-4-1. Visit to the Khartoum Polytechnic in Khartoum on
February 26

Team members were received at Khartoum Polytechnic by Dr. Bushka Abdelmagid, Head of Textile Department, and Dr. Ames Hassan Elshieft, Professor of Spinning. Khartoum Polytechnic trains textile technicians for the growing textile industry. It offers a three-year

program leading to the conferring of "Diploma of Textile Engineering" which is equivalent to the English National Certificate.

The purpose of the visit was to learn about the academic system in the Sudan for training technical personnel for the growing textile industry.

A visit was made to the Textile Institute which is part of the Textile Department's training facilities. The two professors appeared highly dedicated to their profession and proud of the students graduated from the Institute. They hope to expand their program. Members of the visiting team feel that eventually they will also have to train engineering graduates to meet the needs of the growing textile industry.

The Textile Engineering Department has about 70 students and 6 faculty members plus lecturers from the textile industry. The Department awards the previously mentioned Diploma of Textile Engineering to a student who successfully completes 3 years of training. The first class was graduated in 1974. Each graduating class has about 20 members, including at least 2 women per class. Students are required to study subjects such as physics, mathematics (up to calculus), mechanics, engineering drawing, chemistry, textile economics and human relations. Students spend part of each school week in nearby textile factories observing textile operations. In their third year, they spend 3 hours 3 days a week in the mill for actual experience. Female graduates tend to work in quality control departments after graduation. The Institute has no textile engineering laboratory facilities, but is allowed to use the ones in the Textile Institute at Khartoum North. Of the 6 faculty members, 2 are Ph.D.'s, 2 hold teaching diplomas, 1 has a B.S. in Textile Engineering, and 1 has a B.Sc. in Electrical Engineering. In addition, there are 3 technician assistants. The Department hopes eventually to expand its program to a 5-year structure to award a degree in textile technology and to move to Khartoum North for more spacious facilities. Students receive free education, food, and a little pocket money. They are selected from high-school graduates based on scholastic achievements especially in science courses taken in high school.

IV-4-2. Visit to the Khartoum Spinning and Weaving Factory in Khartoum North on February 28

Team members were received at the Khartoum Spinning and Weaving Factory by Mr. Mohamed A. Sarrag, Assistant General Manager; Mr. Mohamed Dowidar, Weaving Manager; Mr. Sid Ahnel Siddik, Spinning Manager; and Mr. Ahmed El Hadi Elbo, Quality Control Manager. This factory spins yarns to supply its own weaving plant to make Wilaya cloth 22 w by 22 f and Damoria cloth 42 w by 36 f (w is warp yarn count and f is filling yarn count).

The team wanted to observe processing operations from opening through weaving, as well as the quality control program and facilities. For this purpose the team was shown the entire factory, including the quality control laboratory, which does not appear to be used extensively, and the inspection room. The team advised the quality control manager to check his carding operation to reduce neps--including card settings and weight of sliver delivered.

The factory has 25,000 spindles and 271 looms. It has 3,000 employees working on 3 shifts. Weaving efficiency of the looms was said to be about 50 percent which is much lower than is standard in the United States. Single-strand yarn strength was checked daily on 10 spinning frames at 10 spindles per frame. Yarn defects are one major source of low weaving efficiency. The combination of low weaving efficiency and dusty quality control laboratory equipment gave us the impression that their quality control program was not strictly followed. Most of the fabrics we saw looked more like seconds than top grade goods. The card webs were also indicative of poor machine settings. We were told that 4 laps were checked for evenness daily as part of the quality control program.

The mill is experiencing an 11 percent absenteeism. We were told that the mill actually needs only about 2,500 people. The additional employees were carried on the payroll to allow for the high rate of absenteeism. Employee migration is also a major labor problem--either leaving the industry or the country. It takes 6 months to train a person to become a spinner or a weaver. When an employee is gone, the 6 months of expense is lost to the factory. This migration also amounts to quite an expensive problem.

IV-4-3: Visit to the Omdurman Knitwear Factory at Omdurman on February 28

The team was received at the Knitwear Factory by Mr. Omer El Musharaf, the owner of the Factory, and Mr. Apostolis Facaros, the person with responsibilities ranging from mechanical to chemical, technical, and sales questions. The Factory manufactures fabrics and finished knit undershirts and thermo underwear for men. The factory is a family-type operation. It has 120 employees and 22 knitters. It uses 14-gauge knitters for thermo fabrics.

The team wanted to observe processing procedures, facilities, and the factory's quality-control program and was able to inspect the whole factory from knitting to sewing and finishing. No step was taken at the Factory to check the quality of incoming yarns and outgoing fabrics except by judging the fabrics for faults. Fabrics with faults were classified as seconds.

The owner is thinking of expanding his knitting and wishes to supply his own yarns if the price is right. Mr. Louis promised to send him a

cost estimate per spindle from opening through spinning (making 30/1 to 32/1 yarns).

At present the factory uses local yarns from the Sudan Textile Factory and the Friendship Textile Mill, but prefers the yarn from the latter for its better quality. The knitters are being blown-down twice a day for a three-shift operation. Yarns are not waxed for knitting. There are three shifts for knitters and one shift for garment-making employees.

The factory uses 12-inch, 14-inch, 13-inch, and 24-inch diameter knitters. The fabric finishing operation consists of a caustic boil and wash. The products are classified as first- and second-class goods.

IV-4-4. Visit to Ascindco, Ltd., on March 1, 1978
at Khartoum North

Members of the team were received at Ascindco, Ltd., by Mr. Idrahim Sobahi, Chairman, and Mr. Mohamed Siddik, the General Manager. Ascindco manufactures men's shirts and aluminum-frame, two-suiter, synthetic leather-cover suitcases. The purpose of the visit was to examine the quality control of products and related programs. Both the cloth-making and suitcase-making lines were visited.

No quality control measurements are made on incoming raw stock of fabrics imported from Japan and Switzerland. The finished shirts are checked at each of the 13 sewing step stations and by the "cleaning" person before packaging.

A high excise tax (10 percent) plus a 5 percent development tax forced the closing of 1 of the 2 shirt-sewing lines. Instead, suitcase making is being expanded to include a steel-frame suitcase assembly line. The new line has a capacity of 200 cases/day. A new building is being erected to house the new assembly line for the steel-frame suitcases. We were told that the taxes mentioned above will have to be reduced in order to avoid curtailment of this type of light industry.

IV-4-5. Team visit to the Khartoum Socks Factory at
Khartoum North on March 1

The team members were received by Mr. John Kassar, owner and Mr. Mohd. Agag, Engineer at the Khartoum Socks Factory which makes nylon socks for men and boys. The purpose of the visit was once again to check the quality control of products and relevant programs. The team was shown the sock-making plant, the sewing room, the heat-set room, and the packaging room.

The factory has three stages at which workers check the socks for quality. These stages are toe-sewing, heat-setting, and packaging. Goods are classified as first and second grades. Seconds are packed in packages of one dozen and without label, and sold at 50 percent discount.

The factory is family-owned and employs an engineer who takes care mechanically of all the knitting machines (7 Italian-made and 11 English-made). He also designs patterns for machines. Five more new English knitting machines are being planned for a new expansion program for which the Factory must first obtain permission from the National Research Council and the Ministry of Industry. The Factory has a long-range plan to add 5 or 6 new knitting machines every 6 years. Nylon yarns used for the socks are imported from Taiwan and the U.K. All the English-made knitters are 12 gage, and the Italian-made are 36 gage. Only 1 size of socks is made for men's wear and 1 other for boys.

As much as 10 to 15 percent of each day's production is second grade, which is mainly produced by the second 12-hour shift when the engineer is not on duty. Female workers can be employed only during the morning shift because there is a law that prohibits a female worker to work after 10:00 p.m. The factory has 11 male and 19 female workers. Female workers are allowed 2 months of maternity leave as well as one day per month with pay. The owner told us that his engineer is leaving him next month for a higher paying job outside of the Sudan. Labor also is a problem here.

IV-4-6. Team visit to the Red Sea Spinning Company, Ltd.,
on March 4 at Port Sudan

At the Red Sea Spinning Company, the team members were received by Mr. Khalid Ahmed Abbas, General Delegated Manager; Mr. Mustaka Aboelraout, Production Manager; Mr. Mohd Yousif, Delegated Manager Director; Mr. Mustafa Abdel Rawaf, Assistant Spinning Manager; and Mr. Mutwalil Abdou, Assistant Spinning Manager.

The Red Sea Spinning Company produces and sells cotton yarns (carded and combed) for domestic consumption and for export to the United Kingdom. The purpose of the visit was to examine the quality control of products and related programs. The team was shown the entire production line, including the opening, picking, carding, drawing, combing, roving, spinning, and winding operations.

The mill uses 1.4-inch staple cotton for all its yarns, which ranged from 24/1 (carded) to 40/1 (combed). This would not have been the practice in the United States. The mill was well run and kept quite clean. It has a quality-control program for yarn and an intermediate processing stage but none for cotton raw stock. It has no fiber-testing facilities, which constitutes the major shortcoming of the operation.

The mill was equipped with American-made textile machinery--from opening through winding. The mill produces sale yarns ranging from 24/1 through 40/1--both carded and combed yarns. Distributions of spinning frames based on yarn counts are for carded yarns; 6 frames

for 24/1 and 30 frames for 32/1. For combed yarns there are 10 frames for 36/1 and 12 frames for 40/1. The mill has been exporting its yarns to Italy and the United Kingdom, but now 75 percent of yarns produced are sold to the Blue Nile mill within the Sudan. The mill has yarn-testing facilities but none for fiber tests. It has been sending samples to the United Kingdom for testing and verification of specification. Red Sea Spinning is experiencing the "honeydew" problem with Sudanese cotton and excessive short fibers in the Acala-type cotton grown in the Sudan. The difference in price between the Acala (65 cents/pound) and the 1.4-inch staple Sudanese cotton (99 cents/pound) is 34 cents/pound.

Mr. Louis agreed to test for the production manager raw stock samples of honeydew affected cotton as well as a sample of Sudan-grown Acala (California-type) cotton to test for honeydew and short fiber content respectively. He would hope to find a solution to the honeydew problem of this Company. It is the most serious shortcoming of Sudanese cotton at the present time.

The mill is currently understaffed both in technical and nontechnical personnel. This is the only mill we visited which is not over staffed to compensate for absenteeism. We were told that the mill sets prices for the sale of yarns. The mill has 12,528 spindles (216 x 58), and produces about 6 tons of yarn per work day.

IV-4-7. Team Visit to the Sudanese Industries Association and the Sudan Cotton Growers Association at Khartoum on March 5

Team members who visited the Sudanese Industries and the Cotton Growers Associations included the textile subgroup and Mr. G. L. Louis, Mr. H. Steffen Peiser, Dr. Mahmoud Salama, and Dr. John K. Taylor.

The purpose of the visit was for Mr. G. L. Louis to deliver a slide lecture on cotton research at the Southern Regional Center of the Agricultural Research Service of the U.S. Department of Agriculture. The audience included textile specialists and representatives of the Industrial Manufacturers' Association.

Mr. Louis described some recent accomplishments and current activities of the four research groups in the Cotton Textile Processing Laboratory of the Southern Regional Research Center of the U.S.D.A. His presentation was illustrated with a set of 35 mm color slides. Special emphasis was given to the following topics: the revolutionary tuft-to-yarn spinning system; the wet-wall electrostatic precipitator; electrostatic spinning; effects of cotton-fiber properties on ring and open-end (OE) spinning; mechanical processing on OE rotor dust; and effects of cotton-fiber properties and yarn sizing on lint shedding

in knitting. Accent of the presentation was on maximum utilization of cotton through systematic research. The audience was very responsive and asked many pertinent questions during and after the presentation.

IV-4-8: Team Visit to Hilal's Factory at Omdurman on March 5

The team was received at Hilal by a young employee who did not speak English. The owner of the factory is Mr. Elt'gani Hilal, who also owns a shoe factory which some of the team visited. The factory makes braided elastic bands for undergarments and braids for neck borders of outer garments. The purpose of the visit was to check for quality-control facilities and related programs. The team saw the one-room family-type operation. There was no discussion during the visit because in the absence of the owner of the factory there were difficulties in communication.

The one-room factory has $24 \times 8 = 192$ braiders which were making braids out of 10-300 denier 50 filament viscose rayon imported from Achi Chemical Industries, Ltd., in Japan. The cord of the braid consisted of 3 strands of elastic bands (round). One person measured off 3-meter lengths and cut these for packaging. The elastic braids are then packaged in 3-meter lengths per pack by about 10 women. No price per pack was given to us although we asked. No quality-control facilities were in sight.

IV-4-9: Team Visit to the Hemired Textile Factory (address P.O. Box 690) in Omdurman on March 5

The team was received by Mr. Saad Ali Hemied, the owner and Mr. El-Tayeb H. Braire, the Manager of the Hemired Textile Factory making fabrics for native wear of ladies. Examination of quality control was again the main purpose of the visit. The team saw the weaving room, including winding and warping facilities, the storage area for incoming yarn, and the inventory room. Mr. Braire is a trained quality-control specialist, having a diploma in this subject, but he does not use quality control in this mill. The reason is the same as in some other establishments. The competition in marketing prevents condemnation of any products as this would increase the cost of items sold; besides everything produced is sold. The mill does occasionally check incoming yarns for color fastness by washing. Yarns are being imported from Japan, China, and Yugoslavia. The mill has 16 looms which weave 32-inch to 46-inch fabrics; and 13 looms for 72-inch width fabrics. They are all IWAMA looms from Japan. Part of the fabrics are for export but most of them are for the domestic market. The mill is installing a Jacquard loom for fancy weaving patterns.

Although no quality-control program, no quality-control facilities, and no incentive for quality-control existed, most of the fabrics produced seemed to be of high quality.

IV-4-10: Team Visit to the Sudan Textile Industry, Ltd., at Khartoum North on March 6

The team was received by Mr. Tag El Sir Mohd. El Hassan, the Technical Department Manager at the Sudan Textile Industry, which has a complete textile mill working from raw stock cotton to finished fabric, plain or printed. To obtain an impression of quality control and assurance programs, the team inspected the complete mill during a tour lasting an hour and a half.

The mill is the biggest and most complete mill seen by the team up to that time in the Sudan. It is independent in operation and has a competent technical staff of 500. It also has 2 quality-control laboratories for fiber-to-yarn and fabric tests, plus a chemical laboratory to check for color fastness and fabric shrinkage.

The mill is large in comparison with the others we had previously visited. It is 17 years old and has no air conditioning. It has laboratories for quality control, but its spinning efficiency did not seem to be very high as evidenced by the amount of ends down in spinning. The card webs produced for carded goods looked very neppy, which indicated poor carding practices, but they would not find time to stop the cards to reset and strip them for better performance. It is not a matter of not knowing how, but they do not want to lose production. The lack of competition in marketing the products caused a lack of incentive for quality.

The mill has 56,000 spindles and 2,000 looms with an additional 1,000 looms from a new addition. The mill spins yarns of 16/1 and 30/1 from Acala-type cotton; spins 40/1, 50/1, and 60/1 from combed Barakat-type cotton. Of the 56,000 spindles, 25,000 were allotted to fine-yarn spinning--the 40/1, 50/1, and 60/1. Fabrics produced included printed cloth, poplin, voile, and jeans for the army. The combed stock section of the mill was more efficiently run than the carded section. There are 9,000 employees in the entire factory. The mill has similar labor problems to those of other mills which we visited in the Sudan.

IV-4-11: Team Visit to the Friendship Textile Mill near Wad Medani on March 7

At the Friendship Textile Mill the team was received by Mr. Ibrahim Saeed Shorbagi, the General Manager, and the Chinese advisers, Mr. S. C. Chiang, Chief Engineer, and Engineers Mr. C. S. Tong, Mr. K. Wang, and Mr. W. J. Gei. The team was grateful for the opportunity to tour the unique facilities of the Friendship Textile Mill from opening through finishing and to observe its quality-control programs. The mill has a fairly complete quality-control program, in that it checks all products at all the stages of processing--from raw-stock fiber tests to finished fabrics. The mill was very systematically laid out

to maximize processing efficiency. Apparently it was meant to be a model mill setup to exhibit the capability of modern Chinese textile technology. Fabrics produced from the mill ranked as the best among all the factories we visited. Processing efficiency probably was quite high judging from the very few end breakages in spinning. Quality-control procedures seemed to be adequate in that products at all stages of processing were being tested, but no quality-control charts were visible anywhere. It was learned that the workers took great pride in their mill and their work. They were eager to learn and exhibited good attitudes toward general mill operation. A medical staff was on duty at the mill. The technical personnel from the People's Republic of China will be leaving for China by the end of 1978, and the management of the entire mill will be handed over to the Sudanese. The Chinese engineers felt that the Sudanese will be able to operate the mill at its present rate of efficiency. In fact, the Sudanese are running the mill on their own now with only occasional advice from the Chinese engineers.

The mill has 1,600 employees at present, running 2 shifts up to the weaving stage, and only 1 shift in finishing. Eventually it will increase to 3 shifts through weaving and 2 shifts in finishing.

The mill uses both Acala and Baraket cotton with spinning yarn counts from 21/1 to 40/1. It has an annual surplus of 150 tons of yarn for sale to other domestic mills for weaving or knitting. It has 25,000 spindles and 864 looms, producing 16 million meters of fabrics a year, which included 2 poplins, a sheeting, a shirting, a sateen, and a voile. The honeydew problem is also experienced at the Friendship Mill but minimized through humidity control.

IV-4-12: Team Visit to the Sudan Gezira Board at Barakat on March 8

Sudanese team members present during the visit to the Gezira Board were Mr. Ahmed Tutti and Mr. Small Hassan. Foreign team members were Dr. John Taylor, Mr. Gain Louis, and Ms. Joan Pring. The team was received by Mr. Hassan Abdalla Hashim, Chairman and Managing Director of the Sudan Gezira Board. The Board manages over 2 million feddans (3,241 square miles) of intensive cropping by tenant farmers of cotton, dura, wheat, groundnuts, rice, and market gardening. The Board promotes social welfare of the population of this irrigated area. The purpose of the team's visit was to see production of important primary commodities, and cotton in particular. A 25-minute film was shown, which summarized the whole operation.

In this remarkable project, state ownership of land and water supplied by gravity irrigation through a system of canals, sub-canals, and sub-sub canals is allied with private enterprise of tenant farmers according to planning advice from the Sudan Gezira Board. Farmers

receive proceeds from all crops except cotton, where they receive a predetermined share. Cotton is picked between January and April and has to be ginned, transported, and cleared through Port Sudan before the rains. Overseas cotton sales provide 40 percent of the total national revenue and 60 percent of foreign earnings.

The Gezira scheme was started by the British after the remarkable Garstin report on the Nile water in 1904 and is continuing to develop strongly as an outstanding socio-economic venture.

IV-4-13: Team Visit to the Barakat Ginning Factory within the Gezira Scheme, South of Wadmedani on March 8

Ms. Joan Pring, Dr. John Taylor, Mr. Gain Louis, and Mr. Lutfi were received by Mr. Asim Abubik, the Deputy Manager of the Barakat Factory, which gins cotton, prepares it for shipment, and collects the cotton seeds. The team toured the ginning facilities to observe the ginning practices. One ginning shed was visited. The gin does not have any quality-control procedures.

We were shown first the room where sacks of handpicked cotton were dumped on the floor. Two operators fed the seed cotton into a hopper (an opening on the floor) with both hands and feet. The seed cotton was then sucked through a system of ducts and distributed to different ginning stands by overhead conveyors. The roller-ginned cotton fibers were dropped to a conveyor apron and eventually fed to two bale presses. Cottonseeds were also transported to a central location to be collected. There was no provision for any type of cleaning for the lint cotton. This lack of cleaning may be the cause for the high dust content found in Sudanese cotton. Cotton dust is detrimental to open-end spinning--a new spinning system which is becoming very popular worldwide. In order for Sudanese cotton to enjoy part of the open-end spinning market, the cotton will have to be cleaned before shipment.

V - Conclusions

A. Food Industries

Team Members

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- °Sayed Hassan Kambal--Sudan
- °Sayed Jozeph Zaki Boutros--Sudan
- °Sayed Mohd. Nur Mahdgoub--Sudan
- °Mr. Benjamin M. Gutterman--U.S.A. (Coordinator)

Introduction

The Food Control Group would like to acknowledge gratefully the organization, management, and assistance from Sayed Ahmed Mohd. Lutfi. As is well known, the Sudan has the potential to become the major supplier of foods to all Arab States. There is already available the land and the knowledge. Modern manufacturing equipment is coming in, and the development of a modern distribution system can be established.

Problems

It is well recognized that in any country undertaking a major development program one will find problems developing during the steps toward attainment of goals. The area of food processing and control is no exception, and the team did find some problems in the Sudan, such as:

1. The team was informed that groundnut oil scheduled for export was generally acceptable to the foreign purchaser but that the "press-cake" residual was often found unacceptably contaminated with aflatoxin. This lack of control causes a loss of export income or loss of product availability for domestic use which could assume significant levels.
2. At the brewery many bottles of beer could not be shipped because the domestically produced bottles were poorly made. Further, a significant number of domestically produced crimp caps were "out of round" or contained inadequate sealing compound. As a result, in many instances, the bottle closures were inadequate to retain carbonation particularly during the higher temperatures of pasteurization. This problem, if uncorrected, could cause lack of consumer confidence in domestic production. Also, at the brewery, many bottles had to be removed from the filling line

because of improperly operating filling heads. These problems as well as that of poorly standardized sizes of bottles and caps increase the costs of production.

3. At the soft drink bottling company, the Survey Team also noted significant production losses. Management informed us that of each 900 cases of bottles going through the line for filling and capping each hour only 800 could be shipped. Here, in contrast to the brewery, the bottles used were imported and were of a much better quality. However, the domestically produced crimp caps were essentially the same as in the brewery and created a problem for the soft-drink bottler. Again, because a large number of caps were "out of round," there were frequent stoppages in the automatic feeder system causing filled bottles to go through uncapped. These bottles had to be emptied and restarted through the process. In other instances, although a cap was put on a filled bottle, the crimp closure was insufficiently secure causing a loss of carbonation. These bottles also had to be rejected.
4. At the biscuit bakery we were informed that only high-extraction flour was available from the flour mill and as such was unacceptable for biscuit making. Therefore, the allotment of available flour required further processing by the baker so as to make it equivalent to a lower extraction flour. This is more costly than if proper flour had been supplied directly by the mills. Of course, the increased cost is passed on to the consumer.
5. On a number of visits to different factories, and particularly in the brewery and the soft drink bottling plants, we observed that quality control was directed primarily to examination of the end product. Admittedly when defects were noted, necessary corrections were attempted, but not until the equipment was shut down for the day. Defective products were not segregated prior to or recalled after shipment. These factors appeared to cause significant reductions in both product quality and quantity of production or substandard products reaching the market.
6. A significant problem noted by the Survey Team was the limited proper transportation to move raw materials to the food factories and then to transport the finished foods from the factories to their destinations. The limited transportation infrastructure coupled with inadequate storage often contributed to spoilage of the product. Delayed transportation thus not only contributes to the higher

cost of foods but also causes unnecessary losses in hard currency. In some instances there can be danger of a resulting health hazard to the population.

7. The team was of the opinion that highly trained scientists were expending significant time and effort in what may have been unnecessary research or at least research of a nature which may have a lesser scheduling priority than for other health and safety problems in the Sudan. For example, in one instance the team observed a highly competent scientist conducting research on a problem of color stability of a food. It appeared that his efforts could be more effective by first carrying out an in-depth literature study accompanied by communication with local and foreign scientists concerning the problems. Food color stability of the nature of this research project is a common problem and may have been already solved elsewhere. We noted a number of similar research activities in a number of laboratories.
8. The Survey Team noted that although the laboratory and inspection technicians as well as professional laboratory scientists and administrators presently serving the Sudan were well trained, there is a serious deficiency in their numbers.
9. There is a demonstrated lack of food standards and of regulations for good manufacturing practices directed toward domestic food production in the Sudan. Further, there is also a lack of established standards for both exports and imports. The Survey Team was informed of what appear to be excessive delays between the establishment of food standards and regulations and their publication in their official publication. We were informed that as of the time of our Survey, no food standards or regulations such as for food additives have been fully implemented despite the fact that several have been available for publication for approximately two years. Although there are some local and national food control programs being carried out, they appear to be informal or are not developed until after an acute problem has caused serious difficulties.

In summarizing the problems, the team recognized that scarce raw materials and limited production of end products are exaggerated by losses at both ends of the supply system because of lack of controls.

Recommendations

1. A study should be made of the cost benefits of reducing production losses by national food control programs in the

Sudan. In many instances the benefits would probably exceed the cost of such programs.

2. Quality control should be directed not only at end products but in-process quality assurance should also be instituted. Critical control-point identification and good manufacturing practices should be provided. Control practices can be based on statistical quality-control procedures freely available from highly industrialized countries and directly applicable in the Sudan.
3. Whereas transportation infrastructure in the Sudan is being improved rapidly, it is helpful to planners to be given an analysis of how unsatisfactory transportation services hurt various industries. The team, therefore, recommends that the food industry in the Sudan should state its problems arising from existing inadequacies of transportation services.
4. More effort should be devoted to planning and coordinating research, as well as to replacing experimental effort on problems which may have been solved elsewhere by more extensive literature searches.
5. More on-the-job training would be beneficial, particularly if provided or supported by the Government. Broadly based training is especially useful because it is largely transferable between industries.
6. Since available personnel have the capability to teach, inspect, and control in the Sudanese food industry, they should be encouraged to do so to a greater extent than at present. Better food handling from the field to the home leads to improved nutrition of the people and to a reduction of food-borne diseases.
7. First voluntary and later mandatory food standards should be developed by cooperation between qualified individuals from industry, consumers, and the Government. The voluntary phase will provide a time for learning and adjustment. Delays in standards development should be reduced, and once a consensus has been reached on a mandatory standard, effective enforcement should follow. To encourage manufacturers and to awaken consumer discrimination, a program of quality marking should be considered.
8. The excess of demand over supply should not be permitted to lead to an inferior product. Manufacturers would

do well to prepare for the day when they might find the supply surpassing the demand.

9. National standards should be harmonized as far as practical with international standards. The Sudan would find it rewarding to be involved in international discussions on food and food processing standards.

Concluding Remarks

The Survey Team is confident that with a recognition of the benefits of a food control program, which is centrally coordinated, combined with an accelerated program of relevant training, and with the full participation of industry, Government academia, and consumers, Sudan will soon take the position of a major supplier of "value added" foods.

The beginnings are already here. Food standards are being developed. Existing standards can be borrowed and adapted from other countries. Food scientists, technologists, production managers, and government inspectors and analysts are increasing in number. The land is being developed for many needs.

Among other developments, the team admired:

1. The Gezira Scheme.
2. The enormous Rahad agricultural project recently opened by President Nemeiri.
3. The project consisting of about 600,000 acres to be managed by a subsidiary of Delgety.

One recognizes that the term "agripower" will truly apply to Sudan.

Sudan must look to the future. Logic dictates that after all the schemes, now in existence and planned for the future, have satisfied the domestic consumption needs of Sudan, a large export trade will follow. The Government of the Sudan should plan and prepare now.

B. Weights and Measures Group

Team Members

- ° Mr. Sayed Ahmed Babikr, Sudan
- ° Mr. Sayed El Amin El Awad, Sudan

- ° Mr. Mohamed Benkirane, Morocco
- ° Eng. Herudi Kartowisastro, Indonesia
- ° Mr. Albert D. Tholen, USA (Coordinator)

Introduction

It is the purpose of this section to report on the existing weights and measures program in the Republic of the Sudan in terms of resources (personnel, facilities, budgets) and services provided to the commercial and industrial activities in the Nation. It is intended here to provide observations and perceptions of the visiting team which will be useful for integration into program planning.

Mission and Objectives

The National Weights and Measures Program is designed to "provide a uniform system of weights and measures in the Sudan and to regulate the use thereof," as laid down in the Weights and Measures Ordinance which further specifies that:

"Every contract, bargain, sale or dealing, and every transaction on which payment in money or kind depends, made or had after coming into force of this ordinance whereby any work, goods, wares, merchandise or other thing which has been or is to be done, sold, delivered, carried or agreed for by weight or measure shall be made and had according to one of the Sudan weights or measures, and if not so made or had shall, as far as it is to be performed in the Sudan, be void."

General Observations

1. The legal basis for weights and measures with the relevant organization and structure has been well established. The development of large-scale agriculture and modern industry has, of necessity and national policy, been spectacular. In the meantime, the weights and measures program has experienced only nominal attention and marginal increases in resources. Demands for weights and measures services are far outstripping the programmed capabilities of the system to deliver needed services.
2. Agricultural and industrial calibration and measurement assurance is essentially (de facto) independent of indigenous Sudanese regulations, traceability, and management.
3. To assess who at this time suffers and to what extent is not a simple task. The present system is also open to some fraud, although it is not clear whether fraud is practiced

and, if so, to what extent. Local officials are on the lookout for fraud more than for the technical competence of those who make the measurements.

Legal Base

1. The national commercial weights and measures program is well based in the Weights and Measures Ordinance and related regulations and procedures.
2. The Ordinance should be promulgated beyond current application to retail transactions into industrial and export/import transactions to which it is clearly intended to apply.
3. The Weights and Measures Regulations of 1956 should now be revised to serve the needs of modern commerce and industry.
4. A handbook of device examination procedures should be written to guide inspectors in the application of regulations in a uniform and consistent manner throughout the nation.

Organizational Structure

The organization is appropriate to the basic mission (marketplace transactions) and its operating procedures are well understood. The team endorses the analysis of urgent needs for:

1. New weights and measures offices in growing commercial centers (estimated need for eight in addition to two at Nyala and El Oiem).
2. A modern calibration laboratory for calibration of weights and measures standards for service to commercial and new industrial development.

Physical Standards and Facilities

1. The Sudan standards and their housing have been minimally adequate for national requirements. The great strides in agricultural and industrial development are straining the system.
2. Two new sets of stainless steel standards should be procured. Consideration should also be given to procurement of a set of aluminum standards.
3. Precise weighing devices are needed to enable the national office to carry out all necessary tests and calibrations.

4. A new central National Metrology Laboratory should be provided to house the national standards and laboratory equipment. An area of approximately 300 m² is suggested. Environment should be shielded from direct sunlight, and it should be dust and draft free. The temperature should be controlled to $\pm 2^{\circ}\text{C}$. The humidity should be kept in the range of 5 to 50 percent.
5. Consideration should be given to alternatives for traceability of national standards to the International Bureau of Weights and Measures either directly or through primary standards of the United States, Britain, Egypt, or other nations with the necessary competence.

Training

1. Individual weights and measures officials, inspectors, and technicians are adequately trained for basic mass, volume, and length activities at this time. For the future, attention should be given to prepackaged goods and electronic weighing.
2. The quantity of trained staff is inadequate today and likely to become seriously deficient unless an intensive training program is established. Such a program should include:
 - ° High-level administrative training in laboratory metrology and weights and measures administration.
 - ° Formal metrology courses at the universities (in Khartoum and provincial campuses).
 - ° Institutional training within the weights and measures organization.
 - ° Resident training of Sudanese leaders and teachers in industrialized countries.
 - ° Active participation in ASMO and international professional organizations.

New Competencies

1. Because of the growth in commerce and the introduction of modern technology, the Sudanese weights and measures program should be expanded not only in size but also in competence.
2. The new program in assaying and marking of precious metals should be vigorously supported.

3. Formally trained staff together with equipment and facilities are needed to service and regulate:
 - ° Electronic and digital devices.
 - ° Large (up to 100-ton) scales.
 - ° In-motion weighing systems.
4. Surveillance of weighing and measurement devices are needed at import/export stations (especially Port Sudan).
5. Development of a calibration and testing program (mass, volume, length) for industries (agriculture, manufacturing, etc.) and universities is recommended.

C. Chemical Industries Group

Team Members

- ° Dr. Fareed el Rayah Hussein, Sudan
- ° Mr. Hassan Mohi el Din, Sudan
- ° Dr. John K. Taylor, U.S.A. (Coordinator)

The Chemical Industries Team visited 10 establishments concerned with production of chemically related materials. In addition, it merged with one or more of the other teams to visit 12 additional organizations. The advance arrangements had been excellent, and the team was well received in each instance by top management who were thoroughly familiar with all phases of the operations.

Management was encouraged to present all operational problems, both major and minor, related to measurement and standardization, and the ensuing discussions were frank and informative. The summaries given elsewhere in this report represent the impressions gained by the Coordinator and are distilled from lengthy discussions of often complex situations.

The overall impression received was that Sudanese industry is trying to do a good job and has considerable potential to produce more and better quality products for domestic consumption and export. Plants are often working under difficulties that would discourage their counterparts in more industrialized countries. They are frequently far from sources of supplies and equipment. Procurement problems seem to be frustrating. Even the obtaining of simple laboratory supplies and minor repairs of equipment can be inhibited by major obstacles. Many of these situations will be alleviated as local sources of supply develop. On the other hand, measurement needs will no doubt increase rapidly in the near future.

Chemical analysis should be considered vital to most of the industries visited, yet it is so far playing a minor role in most cases. There is little awareness of the need for other than the most elementary kinds of testing. If quality, productivity, and cost effectiveness are to be improved, the awareness of chemical controls will need to be increased. There seems to be little, if any, research or development on chemical testing methods or procedures, on their adaptation to Sudanese products, or on the effects of special local situations. Most technology in chemical analysis appears to be based on that used elsewhere.

Much of the testing and analytical work is done by what is called wet chemical methods, with instrumental readout in some cases. No automated analytical procedures or equipment were observed in any of the laboratories visited. Most of the equipment in the laboratories appears to be old. Much of it is obsolete by modern standards or is fast becoming outdated. In several cases, it was mentioned that the laboratories were equipped under a UNIDO grant of some ten years ago. Lack of maintenance, repair facilities, and spare parts has made some equipment inoperative or has impaired its usefulness.

Unfortunately, replacement of most of the chemical measurement equipment in the Sudan is needed or will be necessary in the near future for effective development. This situation should be recognized and a program initiated to plan for this improvement in a systematic manner. The program should recognize that equipment has limited life, due to limited serviceability and obsolescence. A schedule for replacement should, therefore, also be devised.

Concurrent with this plan should be another concerned with providing locally available spare parts and instrument maintenance facilities. A need expressed by several of the laboratory supervisors who were interviewed is for nationally available supplies of chemicals and simple chemical apparatus. The lack of such items, though often low in cost, can be a major impediment to doing experimental work. The procurement of such materials appears to be a major problem. It is relatively very expensive to order such things in small lots. Accordingly, a national plan for such procurement would also prove to be cost effective.

There is only limited awareness of the need for periodic calibration and intercalibration and little or no knowledge of the use of Standard Reference Materials (SRM's) for intercalibration or performance testing. SRM's as available should be used and their use should be encouraged. There should be a program to produce SRM's locally as secondary standards, traceable to internationally recognized reference materials, such as NBS SRM's. This program should also include the development of SRM's that are particularly and perhaps uniquely needed for quality control of Sudanese products.

A major SRM procurement effort should be initiated as well as a program to educate local chemists on their use. A short course could cover quality control of chemical analysis methods, especially those useful for controlling Sudanese production. It is recommended that a handbook on quality control of chemical measurements should be developed for guidance of laboratory personnel in their daily operations. This could serve as the textbook for the course mentioned above. At the same time, the syllabus for the course could serve as the basic outline for the handbook.

The quality of chemical measurements in the Sudan would be greatly increased by a program which encourages chemists to participate in international standardization activities. Such participation would stimulate the appreciation of standardization and would thus be catalytic to local efforts for professional communications within the Sudan. Most of such international cooperation could be by correspondence, but provision should be made for some active participation in meetings, especially if there is a channel for disseminating Sudanese opinions on the application of the proceedings of such meetings.

It is recommended that a reasonably small number of chemists or organizations should enroll as members of pertinent standardization organizations of other countries. For example, memberships in the American Society for Testing and Materials and in the Association of Official Analytical Chemists would appear to be the most appropriate organizations, as far as the United States is concerned. Several of their subcommittees have activities very relevant and clearly beneficial to Sudanese problems. These members would also receive the publications of the respective organizations, which could be circulated locally and which would broaden the base of benefits.

The government-sponsored programs to provide postgraduate training in foreign universities appear to be successful. The Sudanese chemists that have participated in them appear to be well grounded and highly competent. However, there appears to be less knowledge of industrial analytical techniques and procedures. Accordingly, it is recommended that a parallel program of internship in industrial institutions or national standardization laboratories should be instituted and implemented. Internships of one year duration should be adequate. Those completing such a program would learn modern applied chemical measurement techniques, which would be passed along to their associates as they enter the professional Sudanese work force.

Chemical analysis is a key element in industrial development. Good services may be expensive but their lack is much more costly. It is a capability that must be greatly strengthened for Sudanese development. Establishment of a central national facility might be the best, quickest, and least expensive way to proceed. Close association of it with the existing Department of Standards and Quality Control, the Industrial Research and Consultancy Institute, and the National Council

for Research is clearly indicated, but recommendations for the exact administrative structure are outside the scope of this report.

D. Standards and Quality Control Group

Team Members

- Mr. Ahmed Lutfi, Sudan
- Dr. Zakria Abdel Nabi, Sudan
- Mr. Awad Dafalla Hassan, Sudan
- Dr. Abdel Gadir Suliman, Sudan
- Dr. Mahmoud Salama, ASMO
- Miss Joan Pring, UK (Coordinator)

The Standards and Quality Control Group reviewed the considerable progress which has recently been made in the use of standards in Sudanese industries to evaluate quality and reduce waste. The factories which we visited had levels of understanding of standardization concepts varying from good to poor, such as would be expected in any industrialized country; however, an awareness of the possibilities was more evident than expert knowledge of how to apply the principles to achieve optimum efficiency and economy. Only in one case were standards dismissed as "laws" and as a restriction to be avoided as far as possible. Nevertheless, from experience at least in other countries, it is the opinion of the team that good standards practice is more easily introduced without association with mandatory enforcement. However, where for instance, health, safety, or exports are concerned, laws are needed. The policing of such laws should be seen to emanate from other authorities than those who advise on standardization.

Plant breakdowns, shortage of raw materials and trained technicians, and an assured market for everything produced were cited as factors providing no incentive to introduce sophisticated specifications and quality control procedures and to establish production discipline. We learned at the Engineering Department of the University of Khartoum of frustrated plans to introduce a production engineering course; as a long-term investment, such an amenity would have immeasurable benefit. We also noted the suggestion that long-term benefit to the Sudan would accrue if customs and excise allowed free entry of equipment for quality control laboratories in industry.

Previous studies on the use of standards in the Sudanese economy, notably the Sharif and Winser reports, resulted in recommendations on establishing a national standards organization. The Group reviewed organizational aspects in the light of a draft standards law which was extensively discussed. This draft had been prepared by the Department of Standards and Quality Control of the Ministry of Industry.

A standards organization is a professional organizer of agreements. It need not be large, but it must be recognized as a coordinating body which brings together in their own self interest all parties affected by a project. This message of self interest is not an easy one to explain anywhere in the world, because the relevant argument is largely based on not having future losses. We found a good example: a Sudanese soft drink factory is losing 12 percent of its finished product through defective capping of the bottles; in the United States, a comparable plant is said to set aside 4 percent of its production costs for standardization and quality control and has almost no losses in production.

The proposed standards law stops short of the Winser recommendation concerning the independence of the standards organization and this would have consequences which should be carefully considered. If it is to operate in the national interest, under the wide concept of standardization as perceived by international consensus to reconcile sectoral views and coordinating a variety of departments with partial involvement in standardization, the national character of the organization needs to be assured. A typical "national" task, which is at present the responsibility of no one body and which a standards organization should have the capability to tackle, might be a rationalization of designating address and location in the Sudan to facilitate the delivery of goods, minimizing travel distances and times, and keeping of business appointments. Too narrow a concept of standardization--such as the formulation simply of product standards specifying levels of quality--should be avoided.

Our assessment is that the Sudanese economy is ready for such a national organization and the recommendations in the Winser Report should be implemented without further delay. The essential features are autonomy, financial support from the community at large (mainly from a central grant-in-aid), and a recognized function of identifying and coordinating specialized expertise. National membership in international and regional organizations concerned with standardization is another important function of such a body, in order to take advantage of "technology transfer" from world resources. This form of assistance is available once contacts are established, for example, at the practical level of developing visual aids on quality control; this was mentioned specifically as a need to support the education of Sudanese industries.

In any event, strong collaborative ties with laboratories capable of developing and applying test methods is essential. The Industrial Research and Consultancy Institute, for example, could serve that function. We heard that the Ministry of Commerce Quality Control Laboratory had been successful, through the certification of exports of oil-seeds products, in reducing significantly the number of discount claims and disputes. This remedial action in a special situation is a worthy standardization initiative, but it is only a part of the potential benefit from a comprehensive standards operation.

Moreover, it should be noted that ad hoc government regulations to make specific quality levels compulsory are in need of considerable human resources to police them. A requirement to use a national certification mark under a properly designed quality assurance system is more economical and beneficial to industrial practices generally. It was noted that the urgent need for most sectors of Sudanese industry is to have a better understanding of the implementation of quality control at factory level. In this context, the competence and enthusiasm of the IRCI impressed us. The availability of a national certification mark can effectively provide a stimulus and a framework for quality control in factories.

E. Textile Group

Team Members

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The Textile Team visited 13 textile related establishments during its 2-week stay in Sudan. The establishments ranged from the family-owned Hilal Lace Factory to large modern textile mills, such as the Sudan Textile Factory. Of the 13 places visited, 4 are major textile mills. They represent about 120,000 spindles and consume nearly 300 bales of cotton per day. The other factories are smaller in scale, but are important components of the Sudan textile industry. We also visited the Textile Engineering Department of Khartoum Polytechnic, and a cotton ginning factory near Wad Medani. We received excellent responses to questions. During only 1 exceptional visit, communication was deficient because the owner of the factory was absent. The openness and frank manner in which the Sudanese specialists discussed their factory operating problems with the team members reflects their desire for the Survey to succeed in assisting their operations. Some of the impressions and conclusions obtained from the visits follow:

1. The technical personnel who are in charge of the factories are very competent. They know their work well and also realize their problems, although sometimes they do not take time to solve their problems and improve their products perhaps because of the absence of a competitive market.
2. Most large textile mills have quality-control equipment, but in many cases, they are not fully used. In small weaving sheds, managers are aware of quality control and

its importance, but are reluctant to put a quality-control program into practice. It is not easy to deny the typical opinion of management that a quality-control program would incur some added expenses under conditions in which the ready domestic market is eager to absorb textile goods of any quality, whether it be a cone of spun yarn or a bolt of printed fabric.

3. For Sudan textiles in the future to be competitive in the export market after domestic demands are met, the textile industry will have to apply quality-control systems. Gradual and consistent application of quality control programs now will lead to high quality goods suitable for the world market. Implementation of effective quality-control programs means acquiring some additional up-to-date testing equipment especially for the smaller manufacturers. Training competent technicians to administer the programs is another essential step. Of the fabrics examined during our visits, quality ranged from excellent to poor.
4. One of the major problems facing the textile industry, which is really outside the terms of reference of this Survey, lies in labor practices. We encountered the problem of excessive labor absenteeism in nearly every visit we made. Some factories experienced as high as 11 percent absenteeism on any given workday. Management counteracted the problem by over staffing--a luxury which in competition with other countries one cannot afford. Another common and acute labor problem is migration. Semiskilled laborers simply move on to other more lucrative industries or emigrated to nearby oil-rich countries. Constant mass training of replacements for these semiskilled laborers is a financial burden for the textile industry. Remedies are difficult to find, but the industry may wish to experiment with incentive programs based on productivity.
5. The majority of the fabrics produced is of the apparel type. Household and industrial fabrics, such as upholstery and ducking, would be logical expansion fields. Such fabrics, too, have large domestic and foreign markets.
6. At one of the cotton ginning facilities of the Gezira Scheme, the hourly production of lint cotton of the gin was comparable to that of U.S. gins. However, no cleaning equipment or attachment was visible in the gin, probably because the cotton was handpicked and

thus considered clean. Cotton intended for export may need to be processed through a cleaning stage in order for it to be suitable for open-end spinning. Excessive dust in cotton causes processing difficulties in open-end spinning. It is, therefore, recommended that newer methods in ginning practices should be investigated for possible updating of the ginning facilities in order to cope with modern spinning mill demand.

7. The problem of "honeydew" in Sudanese cotton was mentioned to us in several factories. A sugar-like substance causes stickiness of fibers which is transferred to machine parts and thus reduces processing efficiency and the quality of products. Honeydew is not unique for Sudanese cotton; the U.S Cotton crop occasionally is "infested" with it, too. But constant honeydew contamination needs a definite solution. Some Sudan mills are substituting a more expensive, longer cotton for shorter cotton to overcome processing difficulty, but it is not a permanent solution and is economically not rewarding. Humidity control may lead to a preferable solution.
8. The Khartoum Polytechnic seems to have an excellent curriculum for training textile technicians to fill the needs of a growing textile industry. The curriculum includes physics, chemistry, higher mathematics, engineering drawing, and management skills. It is notable that female students are among the graduates of the Textile Engineering Department. We were told that most female graduates went into the quality control department of the mills. As the textile industry grows, it may be well to develop a more encompassing curriculum for training textile engineers, in both mechanical and chemical options. Such a new curriculum may be incorporated in the Polytechnic program or as part of the Engineering Department in the Khartoum University. Sudan will need many more technically competent textile engineers for its expanding industry.
9. With the expanding textile industry, allied industries (or supportive industries), such as machine shops, sheet-metal shops, and small foundries are needed to furnish supplies and spare parts to existing textile machines. These small industries are particularly useful because the textile machines in use have come from many parts of the world. We saw one mill completely equipped with machinery from the United States; another mill was equipped with machinery from

the People's Republic of China. Some measurements of these machines were based on the English system and some on the metric system. Such parts are not interchangeable. We were told more than once of the difficulties in obtaining spare parts for various machines. A quick source of supply of machine parts insures minimum downtime and is indispensable for maximum productivity.

10. Everywhere we went there were signs of expansion. This is a welcome phenomenon for a young industry. It reflects the confidence management has in the industry's future. We, too, feel optimistic about Sudan's textile industry. The sentiment expressed by one of the Chinese engineers at the Friendship Textile Mill sums things up nicely. He said, "The people here are very proud of their mill. They are eager to learn all they can about the operation of the mill, and they have a very good attitude about it." We sincerely feel that what the Chinese engineer said is also applicable throughout the Sudan textile industry as we saw it during our Survey. After a few proper adjustments in some of the operational practices, the industry should have a very bright future.

Appendix A

Ministry of Commerce and Supply

Sudanese Weights and Measures Administration

Our Development Schemes

This administration has carried out an intensive study to promote the weights and measures services all over the country and to introduce new services in other fields.

Some of these projects have been approved and others are under consideration. We give below a summary for each project, which has been prepared by our technical personnel.

Assaying and Marking of Gold and Silver Articles Project

Feasibility studies have revealed a national need to control the quality and fineness of precious metals and to introduce an Act to punish forgery.

Our achievements, with regard to this project, are as follows:

Equipment and Buildings

The Ministry of Construction is giving the final touches to the project for the buildings.

93 percent of total equipment has now been supplied from foreign sources and local markets.

Staffing and Training

A number of chemists (graduates) and technicians have been appointed. Plans have been made to train the technical staff locally and abroad.

Operation

Operation has been scheduled to start within the financial year (1978/1979).

Arrangements have been made to have on secondment an expert to help in operation only and give further training to our technical staff on the spot.

Sudan Metrology Institute

Following the passing of the Weights and Measures Ordinance in 1955 and the issue of the Weights and Measures Regulations in 1956, a school of weights and measures has been established in order to qualify Sudanese weights and measures officers. In consultation with the Public Services Commission, the draft regulation on weights and measures (qualification and duties of officers) was passed in 1957. The trainee officers appointed must initially have full high secondary education.

Then they undergo a three-year training course in the weights and measures field. They study academic subjects in conjunction with practical training. We have suggested that this school should be developed into a metrology institute to widen the scope of training and to be reorganized to contain the following departments:

1. Training of weights and measures officers.
2. Training of highly qualified technicians in calibration and adjustment of weights and measures standards.
3. Qualifying of scale makers.
4. Qualifying of technicians in assaying and hallmarking of precious metals.

Expansion of the Weights and Measures Service

The weights and measures service should expand in step with the expansion of commercial activity as a result of completion of national development plans. Although fair competition in trade practice should be encouraged, yet protection of consumers' interests must remain a background for healthy commercial activities. Accordingly, a theme for the expansion of the weights and measures service all over the Sudan has been made to establish about 10 weights and measures offices functioning in busy commercial centers, in addition to the 13 weights and measures offices. Two of these offices have already been established; but the lack of financial resources has hindered the establishment of the remaining offices. Technical equipment for each office costs about 4,000 Sudanese pounds.

Complete Adoption of Metric System

In many trades, units of the metric system have come in daily use in Sudan, because the metric system has been adopted in this country

since 1955. But some traditional local and foreign nonmetric systems are still in use.

A long-term plan to switch over completely to the application of the metric system in Sudan has been made as a draft by this Administration. The outlines of the plan are as follows:

1. We have proposed that a national commission headed by the Director, Weights and Measures, should be established consisting of representatives of all interested government units and the public sector.

The terms of reference of the commission will be technical and have specialized functions. It will be concerned with giving advice to the Ministers of Commerce and Supply and the Minister of Industry on the smooth application of the metric system.

This proposal still needs approval.

Establishment of a Modern Laboratory for Calibration of Weights and Measures Standards

We have in existence a small standards laboratory for verification of our standards. Experience has shown that this laboratory does not satisfy our needs and does not give very precise tolerances. Accordingly, a plan has been made to establish a modern standards laboratory to cope with commercial and industrial development.

This project has been approved to be implemented within the National six-year Development Plan (1977/1978-1982/1983). Part of the financial cost has been approved by the Ministry of National Planning.

We are now making some approaches to certain developed countries to get their technical and financial assistance.

Appendix B

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APPENDIX C

Abbreviations Used in this Report

AFNOR	- French Standards Association
AID	- Agency for International Development
AOAC	- Association for Official Analytical Chemists
APHA	- American Public Health Association
ASMO	- Arab Organization for Standardization and Metrology
ASTM	- American Society for Testing and Materials
B.S.	- Bachelor of Science
BS	- British Standard (preceding a number)
BSI	- British Standards Institution
CET	- Center for Building Technology (NBS)
DSQC	- Department of Standardization and Quality Control
GOS	- Government of Sudan
IRIC	- Industrial Research and Consultancy Institute
ISO	- International Organization for Standardization
M.S.	- Master of Science
NBS	- National Bureau of Standards
SI	- The International System of Units
sq. ft.	- square foot (1 foot = 30 1/2 cm)
SRM	- Standard Reference Material
SSMCS	- Standards Section of the Ministry of Commerce and Supply
UK	- United Kingdom of Great Britain and Northern Ireland
UK	- Univeristy of Khartoum

- UNDP - United Nations Development Program
- UNESCO - United Nations Educational Cultural and Scientific Organization
- UNIDO - United Nations Industrial Development Organization
- WHO - World Health Organization

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