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philippines

scientific glassblowing (national institute of science and technology)

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INTRODUCTION:

Since achieving independence in 1946, the Phillippines has given high priority to the development of scientific research and training facilities in the country. As part of these facilities, the creation and operation of technical Institutes and scientific laboratories have played a significant rôle. A considerable amount of money has been spent both by the government and by external aid programme in providing much-needed equipment for these laboratories.

It is a fact, however, that upon visiting scientific Institutes where expensive equipment has been installed, one is struck by the amount of such equipment that is inoperative due to lack of spare parts, lack of maintenance, inability to find adequate repair facilities in the country, etc.

Thus briefly, there has been a growing realization, both in the public and private sectors, that there is a need to set-up training facilities in the country so as to provide personnel able to maintain, repair, recalibrate and construct scientific instruments and equipment. Scientific glassblowing, Fine Mechanics, Electronics and Optics are the fields in which these training needs are required.

The Philippines government included in their request for the 1960 U.N. Technical Assistance programme a proposal for a category I allocation of $3,000 worth of equipment and $4,500 for the short-term assignment of a Unesco consultant who discussed with the officials concerned the overall requirements of the proposed Centre in terms of physical space, technical facilities, equipment and staff to work out the phasing of the project, since limitation of Unesco funds would not permit the establishment of all four divisions of the Centre in one year.

The 1961/62 programme carried this plan one step further with the provision in category I of the following:

Assignment of 2 experts (one glass blower and one electronics)
$9,000 worth of equipment
2 six-months fellowships

In the course of this report, one must refer to the National Economic Council as N.E.C., the National Institute of Science and Technology as N.I.S.T., the National Science Development Board as N.S.D.B., and the Scientific Instruments Centre as the Centre.

II. CHANNELS OF CONTACT AND COMMUNICATION:

The National Economic Council, government co-ordinating body, through which all the correspondence regarding the appointment of experts, the award of fellowships should be forwarded to the resident representatives of the United NationsDevelopment Programme in Manila.

The National Science Development Board, whose members of the governing board are representatives of the Philippines Atomic Energy Commission, the

National Economic Council, the National Institute of Science and Technology, the Ministry of Education, the University of the Philippines, the Ministry of Agriculture, the Scientific Researchers Association, and private industry.

The National Institute of Science and Technology where the Scientific Instruments Centre is operating. It supervises the operation and maintenance of the Centre and provides the salaries of necessary technical and non-technical personnel for the laboratories, workshops and administration attached to the Scientific Instruments Centre.

The National Institute of Science and Technology is under the administrative supervision of the National Science Development Board. Its budget proposal passes through the latter which may either recommend or cut down the proposed estimate, through the Budget Commission (Office of the President of the Republic) and finally to the Congress for approval.

The Head of the Scientific Instruments Division who supervises the activities of the four sections of the Centre.

The Unesco National Commission.

III. AIMS OF THE PROJECT:

In order to meet all requirements from the laboratories asking for the maintenance, repair, recalibration or constructing of Scientific Instruments, the Scientific Instruments Centre comprises four sections namely: Electronics Instrumentation, Scientific Glassblowing, Fine Mechanics (Instrument Making) Optical Instrumentation.

The Centre, whose staff is given a 3-year training in the lines mentioned below, offers its services, whenever possible, to any laboratory, governmental or private, requiring its assistance for:

Repair and construction of scientific glass apparatus

Testing, repair and calibration of scientific optical instruments

Construction of optical glass components

Repair and calibration of instruments having mechanical defects

Manufacture of fine mechanical parts and instruments for scientific purposes

Testing, repair and calibration of electrical and electronic instruments.

As part of it, the Unesco expert-in-charge of the scientific glassblowing post has the following duty:

To set up, equip a glassblowing workshop

To give theoretical and practical training to local personnel concerning the construction or repair of scientific glass apparatus

required to operate chemistry or physics laboratories pertaining to Educational or Research Institutions either governmental or private, in the Philippines.

To organize servicing of damaged glasswares and the construction on a small-scale basis of glass apparatus to be used for research or educational purposes.

IV. DURATION OF THE PROJECT "SCIENTIFIC GLASSBLOWING":

From the time the expert took up his assignment on 5 November 1961 up to the date of completion of his mission, five years elapsed during which a workshop was erected, a 3-year training programme was organized and completed and finally, the activities of the section were turned into a small production scheme.

This gain of time is not only due to a faster completion of the building but also to the groundwork laid by the expert during his preliminary talks while on a short-term assignment at the end of 1960, resulting in a rather quick release of the necessary funds. The construction works started in July 1961, several months ahead of the expert's assignment, thus enabling him to start his training on 19 November 1962.

V. FINANCIAL SUPPORT TO THE PROJECT "SCIENTIFIC GLASSBLOWING"

(1) Government contribution (see appendix.)

Besides the construction costs, amounting to two hundred and fifty thousand pesos, of the two buildings where the glassblowing workshop occupies one-seventh of the floor area, the government supported the operational expenses, salaries of technical and administrative personnel, maintenance personnel, representing a contribution of one hundred and twenty five thousand pesos (equivalent to US$ thirty-two thousand dollars.)

(2) Unesco contribution.

	Year	US$	US$
Expert's assignment	1960	3,000	
	1961	3,000	
	1962	18,000	
	1963	18,000	
	1964	18,000	
	1965	19,200	
	1966	19,200	
		95,400	95,400.00

	Year	US$	US$
Equipment	1960-61-62	10,857.96	
(Shipping charges	1963-1964	7,324.30	
not included)	1965-1966	700.86	
		18,883.12	18,883.12
One fellowship 1965 six-months		3,500.00	3,500.00
	Overall contribution of Unesco		117,883.12
(3) Bi-lateral assistance			
United Nations Counterpart funds 1962			2,444.78
British Colombo Plan-1963-Equipment			4,502.26
British Colombo Plan-1964-Equipment			3,533.36
	Overall contribution of multi-lateral and bi-lateral assistance.		128,373.52

VI. FLOOR SPACE OF THE BUILDINGS HOUSING THE FINE MECHANICS, OPTICS, GLASSBLOWING, ELECTRONICS SECTION

The Scientific Instruments Centre covers an area of roughly 1,050 m2 in two buildings divided as follows:

1st Building		Glassblowing		2nd Building		Fine Mechanics	
Electronics and Administration				Optics			
Office of the administration	: 32 m2	Office and Engraving room	: 16 m2	Inspection room	: 16 m2	Office	: 16 m2
Office of the Head, S.I.D.	: 16 m2	Workshop	:104 m2	Roughing room	: 24 m2	Instrument room	: 24 m2
Office of the U.N. Expert	: 20 m2	Store room (materials)	: 17 m2	Machine polishing room	: 24 m2	Electro Plating	: 28 m2
Office of the Counterparts	: 20 m2			Hand Polishing	: 24 m2	Tool room	: 16 m2
Lecture room	: 34 m2			Instruments room	: 28 m2	Machine room	:100 m2
Calibration room	: 34 m2					Store room (materials)	: 11.5m2

= 195.5 m2

Research room	: 64 m2 :	:	:	:	:	:
Standards room	: 34 m2 :	:	:	:	:	:
Electrical room	: 64 m2 :	:	:	:	:	:
Lobby, toilet, stairs	:152 m2 :	:	:	:	Power room toilet, lobby :General store	: 42 m2 :
	= 560 m2 :	= 137 m2 :	= 114 m2 :		= 237 m2 :	

VII. BRIEF OUTLINE ON THE PRESENT-DAY GLASSBLOWING IN INDUSTRIALIZED AND DEVELOPING COUNTRIES:

Before reporting on the completion of the training programme, I would like to emphasize the different conditions prevailing in the glass industry in developing and industrialized countries.

In Europe or in the United States the present-day scientific glassblowing is changing. The trend is that there are two types of glassblowers:

(a) Industrial, making stopcocks, joints and fabricated items such as standard chemical apparatus widely used in laboratory. This glassblower is most of the time specialized and works on a mass production scale, which requires expensive manufacturing equipment.

(b) The research glassblower, who assembles the prefabricated items made by No. 1 and involves the special requirements for research.

The days of the all-round glassblower who, in the United States or Europe, does every part of an apparatus of his own are over. In short, the present-day scientific glassblower attached to a research laboratory procures standard parts from factories, working on a mass production scale, to build the equipment requested by his laboratory.

That is true in industrialized countries whose market is big enough to absorb a production which requires an important investment on manufacturing equipment. But the situation is different in small developing countries which have no industry at all to meet the requirements of the scientific glassblower, compelling him to manufacture parts needed for the construction of glass equipment.

Besides, most of the American or European scientific glassblowers attached to research laboratories are provided with an adequate outfit, glass lathe, cutting machine, grinding machine, lapping machine, or annealing oven, forming tools, all expensive items that the Research or Educational Institution of a developing country cannot afford to buy or does not realize how necessary this outfit

is, taking for granted that a glassblower mainly works by hand. That is not true any more since the development of modern glassworking makes it necessary to turn to more mechanical techniques.

In the light of the foregoing, I am of the opinion one must adjust the training programme to the existing conditions prevailing in the country of duty. To illustrate this, I cannot give a better example than that of one of my former trainees who was recently offered a position at ATENEO, one of the leading universities of the Philippines. He was provided with only a bench, a blast burner, a few hand tools and had no machine nor elaborate forming tool at his disposal. However, Father Schmidt, head of the Chemistry Department to which my former trainee is attached, has not enough words to express his satisfaction for the services rendered by his glassblower who, if he had been given intensive training on mechanical methods instead of handwork, using the simplest tools, would have been kept idle awaiting an equipment whose availability may take years.

I can predict that all the outgoing trainees who will get a job outside our Centre, whose the glassblowing workshop is the only one well-equipped Unit in the Philippines for years to come, will face the same problems as that of their schoolmate.

That is why an important part of the training programme was devoted to bench work so that the trainee be prepared to work in hard conditions. Nevertheless they were also given courses on methods requiring the use of machinery such as glass lathe, grinding machine, cutting machine, annealing furnace, forming tools, etc.

They were not specialized since they should be able to make any kind of operation involved in the construction of an apparatus, keeping in mind they will be assigned to laboratories and not to mass production factories that do not exist.

To fill the gap created by the absence of the aforesaid industry, I strongly recommend that a small factory, owned by a private firm, concentrating on the manufacture of standard items such as glass joints, stopcocks, plugs, burettes, pipettes, be established, working on a production scale to enable the scientific glassblower or the department concerned to procure the parts needed in his everyday work in the laboratory, and not to depend any more on the import of such item.

VIII.TRAINING PROGRAMME:

(1) Completion of the training programme in scientific glassblowing

Thirteen regular trainees have studied scientific glassblowing for three years, when only five or six are sufficient to staff the glassblowing workshop of the Scientific Instruments Centre later on. There are two reasons for that:

(a) Training in scientific glassblowing, as in any other trade, is an expensive operation. Machinery, tools, raw materials are costly, salaries and operational expenses are high. Thence the need to increase the number of trainees in order to minimize the costing of the training.

(b) There is not a single glassblower in any of the several leading universities in Manila or outside, which Institutions have hundreds of students enrolled in chemistry who should be provided with teaching aids mainly made of glass which require the full-time services of a glassblower for their repair or manufacture.

Santo Tomas University, University of the Philippines, Far Eastern University of Manila, San Carlos University of Cebu City, Mindanao State University of Marawi City, Siliman University of Dumaguete City, are contemplating to open position to scientific glassblowers. Ateneo University of Manila initiated the drive by retaining one of my trainees two years ago and offered him a position the day after he completed his training.

Emphasis should be put on the usefulness of such a technician assigned to a chemistry laboratory and the advantage that flow from his services, even if provided with the most elementary outfit:

reducing to a few hours or a few days the delay of several months involved in the delivery of scientific glass items which so far are imported.

saving a great deal of money by repairing glass apparatus which otherwise would have been considered as lost for the laboratory.

making cheaper than that of imported glassware the cost of locally made apparatus, taking into account a cheaper labour, no customs duties nor dealer's benefit.

The three-year training programme, which was started on 19 November 1962, has been completed on 30 November 1965. Thirteen trainees, have received a certificate of training awarded by the Commissioner of the National Institute of Science and Technology, Manila, during a graduation ceremony held on 3 December 1965.

The training programme was based on the following schedule: working hours from 8.00 a.m. to 5.00 p.m., with one-hour break for lunch, from Monday to Friday both inclusive, all the year round.

This programme was a systematic one, since the trainees, who had no previous experience in this line, took every exercise in the given order, each of them being mastered before attempting the next one. It was mainly devoted to bench work in order to develop manual skill. However, a fair amount of theoretical work, lecture-type training, was also included in the course of the programme, whose details are given in annex II of this report.

After interview of 35 candidates, 34 of them have undergone a 3-month testing period in order to ascertain their aptitude. On 1 April 1963, thirteen only outgoing high school students between 18 and 22 years old, have been selected as trainees in scientific glassblowing within the National Institute of Science and Technology. They were subject to rules and regulations applying to the NIST Personnel and were on the payroll, receiving four pesos (equivalent to 1 US dollar) per working day, stipend which was raised to five and six pesos later on.

During the first year, they were given practical training on the basic operations, fundamental seals, and all exercises intended to enable them to make, during the second and third year, the standard apparatus widely used in any chemistry laboratory. This is more or less the training applied in any school and the basic background the trainees acquire, but it will take them several years to widen their knowledge that can only be gained through experience and practice by producing elaborate equipment upon request of researchers and science teachers.

In the course of this training, they have not mastered by far all techniques pertaining to today glassblowing that requires on-the-job training which is based on orders from the scientific staff of the laboratory, as it refers to high vacuum technique and equipment, calibration and engraving, glass-to-metal seals, silvering of glass, fractional distillation, which takes years to assimilate. Only professional glassblowers with a long experience and aptitude can attain to such a mastery. I wish to cite a few words of the president of a scientific glassblowers association who said: "It takes me ten years to train a boy to be able to make anything that comes in the workshop".

During the last six months the following training was given:

Dividing of flat scale and ring marking by using a Universal dividing machine.

Engraving numbers and letters by using a pantograph.

Etching by hydrofluoric acid.

Lathe operations such as, blowing of bulbs, sealing of two tubes, ring seal, Dewar's Seal.

Shaping of glass joints.

I could not train the boys on the construction and operation of a vacuum system due to lack of time as I had to attend to the numerous requests flowing in the workshop. This can be done by my counterpart upon return of his fellowship which will give him the opportunity to acquire the technical know-how to build pumps and accessories of a vacuum system.

On account of its specific purpose and its wide range of sealing methods, training on glass-to-metals seals is not included, to my knowledge, in the regular programme of a glassblowing school, since there is no systematic training in this line. Only glassblowers attached to electronics or physics research laboratories are given the necessary on-the-job training which takes a few years of practice to acquire the technical know-how, which is entirely different than that required to make chemistry apparatus.

Moreover, chemistry laboratories in the Philippines which outnumber physics or electronics research laboratories focus attention on the need for glassblowers able to make glass apparatus for chemistry purposes. Therefore only a short training was given on platinum wire and foil seals, Dumet multi-wire pinch seals, tungsten wire seals, due to lack of both time and materials.

CONCLUSION:

Looking back over the five years spent to set up the glassblowing section the expert can report that this section of the Scientific Instruments Centre has developed into a well operating Unit whose staff is able to meet most of the requirements of the laboratories. Eight months were devoted to on-the-job training added to thirty-six months of regular training. I am confident that my counterpart will gather, while on fellowship, additional information on the latest methods used in the glassblowing trade.

IX. SERVICES RENDERED BY THE SECTION "SCIENTIFIC GLASSBLOWING":

The "Scientific Glassblowing" section of the Centre has received as of 27 November 1966, three hundred and thirteen requests from the N.I.S.T. laboratories alone. Its services were extended to laboratories pertaining to scientific and educational institutions, either governmental or private, universities, industrial firms asking for construction or repair of glass apparatus. Five hundred and thirty-eight requests have been received and carried out.

Here is the breakdown of our services:

N.I.S.T.	Other Institutions
Year 1964 - 87 requests	25 requests
Year 1965 - 99 requests	135 requests
Year 1966 - 127 requests	378 requests
= 313 requests	= 538 requests

An interesting experience was made as to the assistance that may be given to schools. Taking the Don Bosco Technical Institute, which accommodates hundreds of students, as a pilot project, our Section has supplied 952 items representing 36 different types of apparatus needed for physics or chemistry courses. What was done for one school can be repeated for the benefit of others, provided our Section has the necessary means (raw material, manpower) to do so. Besides our regular training, courses from six months to two years were given to three laboratory technicians from the College of Agriculture of the University of the Philippines, the Bureau of Research and Laboratories, Muller & Phipps, Inc. After they graduated, three among my former trainees were offered a position as scientific glassblower at:

The University of the Philippines, the only State University in Manila. It accommodates 400 students in Chemistry.

The Ateneo University, one of the leading Universities in the Philippines.

The Philippines Atomic Energy Research Centre.

Seven former trainees have been given a position to staff the glassblowing workshop of the Centre. Unfortunately, six of them do not hold a permanent position, being hired as casuals.

X. RECOMMENDATIONS:

As one can see by reading this report, the scope of services rendered by the "Glassblowing" Section of the Centre steadily increases every year. To attain at the goal, the project has been financially supported both by the government, multilateral and bilateral assistance.

The day the project is taken over by the government, that is, 1 January 1967, there will be no more Unesco assistance as to supply of machinery, accessories, tools, spare parts, raw materials.

Therefore, to cope with the increasing number of requests expected to flow in the workshop in the years to come, the NIST should meet with the requirements of the "Glassblowing" Section as to its operation and maintenance.

It should:

Maintain sufficient qualified personnel (glassblowers)

Ensure the constant supply of raw materials (glass tubing, tools, spare parts).

To meet with these requirements, I strongly recommend that the NIST reconsider its policy regarding:

The recruitment of technical personnel

At the present time, six out of seven glassblowers working at the Centre are casuals who, as they do not hold permanent position, can be laid off any time.

Here is an example: my two best former trainees have been definitively lured away. One has been offered a position at the Ateneo University the day after completion of his training when the NIST was still making up its mind whether they could afford to hire him or not. The other one, once a casual since 19 April was laid off on 30 June, deadline of the fiscal year here. He was offered a permanent position and a much better salary at the University of the Philippines. Both of them have been replaced by two boys who do not have by far their technical know-how and skill.

If one wants to keep the remaining reliable personnel, one must offer them a permanent position with a decent salary, that is the only answer. Otherwise the workshop will be entrusted, sooner or later, to unqualified hands to the prejudice of its operation.

The constant supply of raw materials, tools, spare parts. All the machinery, tools, raw materials, spare parts, used in the "Glassblowing" workshop have been imported through Unesco or the Colombo Plan.

If the NIST cannot reconsider its policy regarding the provision of the necessary funds, the Centre will face in the future great difficulty to replace the materials, tools, parts needed for its operation and maintenance. Procedures

that prevail here make it rather impossible to order equipment which has to be imported, and also very difficult to buy locally available ones whatever its costs.

To overcome this problem a proposal was made to the Congress to authorize the Commissioner of the NIST to spend any income, deriving from the charge paid by the laboratories for its services, for the purchase of the needed facilities to avoid delay involved by going through the routinary requirements of the special budget. It is most unfortunate that such a proposal has not been approved by the Congress, making the Centre depend entirely on the very limited funds the NIST puts at its disposal.

One must realize that it is not only the glassblowing section but also the three others, Fine Mechanics, Optics, Electronics which will suffer, since they will face the same problems.

ANNEX I

TRAINING PROGRAMME

1st Year

Brief history of scientific glassblowing

Shop vocabulary and safety rules

Glassblowing equipment

Gas air and oxygen supply

Type of Burners, their adjustment and operation

Hand tools, shaping tools, calipers and gauges

Identification of glasses, their chemical and physical properties, cleaning

Strain detection by means of a polariscope

Removal of strain by annealing

Operation of an annealing furnace

Elementary Operations

Rotation of glass tubing

Pulling points

Cutting

Straight seal of tubes of same diameter

Blowing of bulbs

Flaring of tubes and bulbs

Bottoming (round and flat)

Making constriction

Bending

T-seal

Y-seal

T and Y hose connexions

Thistle funnel

Kipp's generator funnel

Drying tube

Absorption tube

Ring seal

Insertion ring seal

Side ring seal

Ring seal Dewar type by hand

Close circuit seal

Coil winding

2nd Year and 3rd Year

Use of rollers, forming tools and moulds

Making straight bore stopcocks

Making hollow straight bore plugs

Forming of glass joints

Making Chemical Apparatus

Aeration tubes, thermometer wells

Cold traps

Dewar traps

Open and closed manometers

Hempel pipette

Honeycomb and Vigreux columns

Liebig condenser

West condenser

Allinn condenser

Graham condenser

Spiral condenser

Double surface (Davies) condenser

Distilling apparatus

Micro-Kjeldalh apparatus

250 cc sparating funnel

Geissler alcalymeter

Soxhlet extraction apparatus (extractor, condenser, receiver)

10. Machine work

Cutting of tube at any angle

Grinding of cones, sockets, stopcocks and plugs

Drilling of tubing and sheet

Lapping of flat surface

11. Lathe work

With practice, most types of apparatus used in chemical research can be made by hand. Even so, the most experienced glassblower finds many uses for a glassblowing lathe which makes the work easier, faster and more accurate. Thence, the usefulness of training in this line appearing so obvious, some courses on glass lathe operations such as : making straight seal; bottoming; sealing of tubes of different diameter; blowing bulbs; Dewar seals; expansion bellows; forming glass; were included and two machines, one from Edwards Ltd. of 12-inch clearance between spindles, intended for small operations and the other, of standard type, 37-inch clearance between spindle, 3-1/16 inch hole through spindles, swing over bed 18" from EXE engineering, were ordered, the latter being the one intended to train the boys on the working methods above-mentioned.

ANNEX II

List of laboratories pertaining to Universities, Colleges, Research Centres, Industrial Firms who received assistance of the Scientific Instruments Centre in 1965.

ESSO Gasul Co.
Rizal Provincial Hospital
College of Medicine
Medical Research Centre NIST
Food and Nutrition Centre NIST
Industrial Research Centre, NIST
Regal Medical Equipment Services
Veterinary College U.P.
Hoover Philippines Inc.
General Offset Press Inc.
Electronics NIST
Manila Machinery and Supplies
Bureau of Forestry, U.P.
US Veterans Administration
Test and Standards NIST
Nutritional Products
Chemical Research, NIST
Immaculate Conception Clinic
Bureau of Mines
SUGECO
Micro-Biological Laboratory
Ateneo de Manila
Documentation Centre, NIST
Mopix Production
Dairy Training and Research Institute
Philippine Atomic Research Centre
Muller & Phipps
Records Section, NIST
American School
Chemistry Dept. Iloilo College
Biology Department, NIST
Medical Research Centre, NIST
Antibiotics Department, NIST
Agricultural Research Centre, NIST
Parasitology Dept. Institute of Hygiene
Mapua Institute of Technology
Medical Microbiology, Inst. of Hygiene
Adamson University
Davao Weekers Cc.
Chemistry, Far Eastern University
General Educational Equipment
Ateneo de Davao College
Don Bosco Technical Institute
Kamara Pharma. Inc.
Sterling Products International
Epifanio de Los Santos College
Firestone Tires and Rubber Co.
Dept. of Physiology, Coll. of Medicine
De la Salle College
Far Eastern Technical Institute
University of Santo Tomas
Inhelder Inc.
Circon Laboratories
National University
Polytechnic College of the Philippines
Vick International
Resins Inc.
Forest Products Research Institute
Philippine General Hospital
Philippine Cement Corp.

Philippine Match Co.
San Miguel Co.
Institute of Applied Geology, U.P.
Ceramics, NIST
AID/Health Division
Mary Immaculate Clinic
Manila Machinery
Deep-Sea Fishing Development Project
Department of Pathology, UP
Bureau of Research and Laboratories
Philippine Fisheries Commission
Far Eastern University
Santa Scholastica College
Franklin Becker Corp.
Hygrade Chemical Manufacturing Co.
UP College of Agriculture
Union Textiles
Republic Glass Corp.