The harvest of 35 years of papyrus experience by Dr. Hassan Ragab Ph,D,MSc.

His theoretical knowledge coupled with his experimental work gave Hassan Ragab a chance never offered before to other persons dealing with papyrus. This permitted him to aquire first hand knowledge about many aspects and to correct many falacies attributed to papyrus by many writers who aquired their knowledge only by hearesay and not by direct experimental work. Pliny's account which remained for a long time the "locus classicus" on the process of papyrus manufacture, is the most misleading text about this subject. Generally acceptable accounts of ancient papyrus and its manufacture are available in classical handbooks and encyclopedias, subject here and there to correction in some details which long remained disputed or misunderstood. Correction of such obscure details comes only from practical experiments seeking to replicate the ancient process of manufacture.

In the following are some of the obscure points in the papyrus manufacture which Ragab was able to illuminate during his 35 years experience in papyrus growing and manufacture:

1- The writer discovered why a papyrus sheet should be made of two layers of strips put transversally.

The reason is that the tensile strength lengthwise of the strips, being reinforced by the strong fibers of the vascular bundles, is nearly four times the tensile strength in the crosswise direction composed mainly of soft parenchymatous tissues.

To equalize the tensile strength in the two directions of a papyrus sheet , two layers of papyrus strips are put transversally

2- How the papyrus strips adhere together to form a papyrus sheet. About this subject many proposals were put forward:

Pliny the Elder: Presented that the silt (mud) in th Nile Water acts as cementing glue.

Aboul Abbas Annabati specified that the Egyptians used a glue made out of water and the fruit of the Lotus (Nymphaea).

James Bruce was the first to attribute the adhesion of the strips to the presence of sugar in the sap of the plant.

F.N. Hepper and T. Reynolds of the Royal Botanic gardens, Kew, made a complete analysis of the sap of the papyrus pith and discovered that it contained galactose and arabinose which are well-known natural gums.This supported chemically the conclusion reached by J.Bruc.

Hassan Ragab was able to prove that none of these hypothesis was correct. He was able to prove that adhesion of the strips is attributed to the phenomenon known as Hydrogen Bond which bonds the fibrills of ordinary paper together.

3- A papyrus roll if left without any pressure applied on its surface to keep it flat would curl around its axis to form a scroll. Dr Ragab was the first to discover that the reason for this self-rolling is due to the fact that coefficient of contraction in the lengthwise direction of the strips is much less than that in the crosswise direction of the same strip.

This self-rolling phenomena of the papyrus roll gave the ancient Egyptians the idea of having the papyrus book in the rolled form.

4- A papyrus sheet is made of two layers of freshly sliced strips from the pith of the fresh plant.The working season of papyrus manufacture was limited in the past to the harvest season (June-September in Egypt).

Dr Ragab discoverd that the manufacturing season could be extend-end far beyond the harvesting season by drying the sliced papyrus strips in the sun.

This permits storage of the strips for any required length of time; few days,week, months or even few years

On immersing the dried strips in the water for a day or two they restore their fresh form and become suitable for papyrus manufacture in the same way as the fresh strips.

5- Prior to using the fresh papyrus strips in the manufacture of papyrus sheet they have to undergo a preparatory operation which consists of distroying the paranchymatous tissues to render them suitable to adhere together to form a papyrus sheet. The distruction of the parenchymatous tissues could be achieved :

a- Chemically- by immersing the fresh strips in a solution of Caustic soda, a process followed for its easiness by nearly all papyrus manufacturers in Egypt today, which is not recommanded by the author as it greatly affects the longevity of the manufactured paper.

b- By hammering the strips with a mallet. This was followed in ancient times .

c- By rolling the strips by any means of rolling pin.

Dr. Ragab discovered that this could also be achieved by freezing the fresh papyrus strips in a(deep freezer). The freezing operation would destroy these paranchymatous tissues and render the strips after defreezing suitable for papyrus sheet making. Furthermore Dr Ragab discovered that the freezing operation yields a paper of brighter colour than that produced by the other above mentioned processes.

6- The preparation of thesis that Hassan Ragab presented to obtain his Ph.D. about papyrus brought him to study in a very minute way every part of the papyrus plant, with the result that he accumulated a first hand botanic study of the Cyperus papyrus L.

7- In 1960 Hassan Ragab started his study of the papyrus plant. To do this he had to overcome a very important difficulty as papyrus was no longer extant on a scale large enough to allow him doing this. Ragab overcame this difficulty by travelling to the Sudan where it was known that Cyperus papyrus grew abundantly in the

Region in the upper reaches of the Nile. There, he was able ring back some few rhizomes which he planted on the bank of the at Gizeh (very close to where he was living), in a small plot served him as a nursery. After one year Ragab had enough ts to enable him to grow a small plantation which permitted him tart his experiments of papyrus sheet making. Thus it could be med that Ragab was the first to bring back to Egypt the Cyperus pus plant after its disappearance for nearly 1000 years.

The availability of Cyperus papyrus plant permitted Ragab to em- k on a long and tedious job which took him over three years of ard experimental work until he was able to produce his first papyrus heet in 1964.

After Ragab's success in bringing papyrus papermaking back to life and in drawing on it some copies of ancient Egyptian paintings which were welcomed by the tourist flourishing industry, papyrus sheet making went like wild fire in all the regions suitable for papyrus growth in Egypt. Now Ragab can claim that he is the first to bring back to life papyrus sheet making industry in Egypt. During the past 35 years of a flourishing papyrus industry, Ragab was able to produce and to export to different parts of the world more than 10 million sheets of papyrus paper.

9- The account which Pliny has transmitted to us about the manufacture of the writing material from the papyrus plant is so confused, both from obscurity of style and from corruptions in the manuscript, that there is much difference of opinion as to the meaning of many words and phrases employed in his narrative, and their application in particular points of detail. His account leaves the clear impression that he never witnessed the manufacture of papyrus at first hand. We still ignore the source from which Pliny drew his information.

Editors have wrestled with the text since the Renaissance, and in the past two hundred years a succession of commentators has subjectd it to the most minute scrutiny.

As papyrus production on a large scale was never practiced since the tenth century A.D. the polemic about Pliny's account continued with not one source to tell us the truth about the exact process of papyrus manufacture and to settle all the ambiguities creaded by.Pliny's account.The long experience which Dr. Ragab did acquire during his work for 35 years in papyrus sheet making permitted him to settle many of the ambiguities in Pliny's account and to correct many of the falacies mentioned in this report.

10- The late President Sadat of Egypt asked Dr. Ragab to produce a papyrus that would replace the parchement paper which has been used for a long time in the archives of the presidency in presenting citations for the important decorative orders, credential letters presenting Egyptian ambassadors to foreign Heads of States...etc. This parchement paper was imported since no local industry produces it in Egypt.

So the reqiured papyrus paper should have the following characteristics:-

a- A smooth surface void of any irregularities..

b- Should not curl around itself if exposed to any variation of the surrounding temperature.

c- Contains a water-mark presenting the Egyptian governmental seal.

As the papyrus produced following the old classic system of production does not comply with the above mentioned specifications, so a new kind of papyrus paper has to be devised. After several years of experimentation Dr.Ragab was able to produce the required kind of paper. (fig. 5). During this period President Sadat met his very sad death on October 6, 1981, and interest was lost in this paper. Now the only hope is to use this very high quality of Papyrus paper in the certificates of degrees for distinguished students in the Egyptian Universities.

1- It is to be noticed that the art of restoration and conservation has greatly advanced in recent years for nearly all antiquities and works of art except in the field of papyrus restoration and conservation.

In the restoration of all antiquities and works of art, the materials used in this process are selected as far as possible of the same materials of which these antiquities and works of art were originally manufactured.

Among these antiquities only papyrus makes an exception to this rule. So, all damaged papyri were never restored by the use of papyrus for this purpose but other materials are being used mostly Japanese paper and the like.

The reason could be attributed to the fact that neither the plant, nor its strips nor the pulp made thereof are available or ever tried in the restoration.

Dr. Ragab was the first to propose the use of papyrus strips and papyrus pulp to restore old papyri suffering of holes and dammage caused by insects and rodents.

Fackleman the famous papyrus restorer once proposed small cuttings of old papyri by turning them into pulp to be used in the restoration of damaged papyri, however this was never tried in practice.

Definitely the use of pulp made out of fresh papyrus would be far stronger and more suitable for restoration purposes than using pulp made out of old papyrus cuttings.

12- For the restoration of damaged papyrus suffering of holes caused by rodents or insects notably those of the order of Coleoptera, Dr. Ragab invented the first Papyrus Restoration machine

Description of Ragab's Restoration Machine

The machine consists of a box containing an electric aspirator which when run causes vacuum inside it. There is a swtich to controle the speed of the aspirator and consequently the vacuum inside the,

box to the required amount .

The top of the vacuum box is coverd by a plate of plexiglass having a circular opening in its middle (fig 6). The opening is covered by a movable fine wire gauze. There is also a thick blanket of black rubber having an aperture slightly larger than that of the plexiglass opening. Inside the vacuum box there is an electric lamp which illumination is controlled by a variable resistance.

Modus Operandi

a- The damaged papyrus manuscript with the recto (written) side is laid on the plexiglass cover in such a way that its holes to be plugged are put on top of the plexiglass opening after covering it with the fine matallic gauze.

b- The vacuum is then develped. This brings the manuscript to stick firmly on top of the plexiglass cover, then the rubber blanket is laid with its aperture opposite the opening of the plexiglass, exposing the manuscript holes to be plugged.

c- The light of the inside lamp is put on and its illumination is brought to the most suitable degree.

d- With a tweezer a small piece of the freshly prepared papyrus pulp is carefully applied to the holes to be plugged in the manuscript and by means of a mall spatula the pulp is delicately spread evenly in the hole.

e- The suction of the air through the hole helps this operation and helps ridding the pulp of any excess water

f- The illumination of the lamp inside the suction box, against which the holes under repair are visible permits the restorer to spread evenly the required amount of patching pulp. A magnifying glass helps further performing this delicate operation in a very accurate manner.

g- Having finished patching the holes, the manuscript is covered on both sides by two pieces of blanket felt and put to dry in a hand screw press.

ter drying, the patched holes are further reinforced on the side by sticking thin dried papyrus strips with Arab gum or ther suitable gum. This would end the patching work.

Dr. Ragab has invented an incubator which would confer artificial aging to a newly painted papyrus to give it the aspect of an ant one.
his incubator the damp atmosphere and temperature proper to the tion of fungus culture are developed and in a short period this us would start attacking the papyrus painting turning its surface colour to brown and dotting it with dark spots simulating the aspect of old age.(fig. 7).

14- The alarming rate of increase of air pollution dangerously affecting the atmosphere of big cities where exist museums and big libraries, constitutes a great menace to the antiquities and works of art whether exposed or stored in these museums.
In a paper presented to the XVII International Congress of Papyrology, held in Naples, 1983, Dr.Ragab was the first to draw the attention to the most damaging effect brought to papyrus exhibited or stored in these museums by this alarming increase of air pollution. In this paper Dr.Ragab predicted that at the present rate of damage, caused by this pollution the world heritage of papyrus manuscripts will disintegrate into powder within the coming 50 years. Signs of this catastrophe started to show in some museum. To ward off against this state of affairs Dr. Ragab proposed to establish an International Papyrus Conservation and Restoration Centre, the object of which is to lay the foundation for a new technology based on scientific research led by competant personnel in the field to help prolong the life of the existing papyri and to make exact replicas of the badly deteriorating originals which are to be drawn out of circulation and conserved in air-conditioned stores to keep them out of the reach of polluted air, light and other destructive

elements. The audience of this Naple's Congress approved of Ragab's proposals and it was hoped that Dr. Ragab Papyrus Institute in Cairo would take charge of this very important job.
However, so far nothing has materialized yet.

15- It is well known that Hieroglyphs are the letters used in Ancient Egyptian writing. Each letter is a picture of something familiar to the Ancient Egyptians - such as an old man leaning on a stick, a cow suckling her calf, a clump of papyrus or a boat.. etc. It takes a long time to write the picture letters clearly. To expedite this Dr. Ragab invented the first Hieroglyphic typing machine.(fig. 8).
This machine consists of a circular disc, at the perifery of which are fitted 26 rubber stamps each of which represents one of the 26 letters of of the Hieroglyphic alphabet used in writing personal names.(fig. 9). The circular alphabetic disc rotated by hand around a pivot fixed to a block which could slide up and down against a rubber by means of a lever attached to it.
On the face of the alphabetic disc are marked the 26 letters at its edge, in such a way that each letter is fixed opposite to the rubber stamp corresponding to the same letter fixed at the periphery of circular alphabetic disc (Fig.10).
The peripheral rubber stamp letters should be inked prior to using the machine. This is achieved by means of the inking wheel, which periphery is fitted with a felt inking band. After applying a few inking drops on the felt band, the inking wheel is brought to touch tangentially the alphabetic disc. Giving this latter few turns by hand would permit inking the whole of the rubber alphabetic stamps at the periphery of the alphabetic disc, thus making the typing machine ready for use.
To write a name, a piece of the papyrus sheet is put under the alphabetic disc. Then this disc is turned by hand so that the first letter in the name comes to stand on top of the papyrus sheet. Moving the lever operating the alphabetic disc downwards would

permit the stamp of the first letter to be printed at its proper place on the papyrus sheet. The same procedure is followed in writing the remaining letters until the complete name is written.

16- Papyrus remained the chief writing material from about 3000 B.C. until the ninth century A.D., when the advent of paper-making by the method invented by the Chinese Tsai Lunn 105 A.D. was known outside China. This Chinese method supplanted the manufacture of papyrus as an essential industry, which led to the gradual disappearance of papyrus in Egypt until complete extinction took place around the twelvth century A.D.

The essence of Tsai lunn's method of paper manufacture is the use of the cellulose of the wood of any kind of plant and in particular of forest trees which proved to be the most economical. It takes forest trees from 20 to 30 years to attain its economic size to be cut for paper manufacture.

However, the increase in the number of population coupled with the spread of knowledge led to cutting greater numbers of wood trees to feed the growing number of hungry paper mills which are mushrooming in every corner of our world. The present rate of cutting wood trees proved to be detrimental to the environment. As people , especially in advanced countries become more conscience to preserve the environment, so they have started to oppose cutting its trees which has greatly affected the wood pulp market and the price of paper. This unhappy situation led to start an intensive search for other members of the plant kingdom to supplant wood trees.

After many years of study and research work Dr. Ragab has come to the conclusion that if papyrus could be cultivated in its proper environment on a large scale especially in cheap desert wasteland which could be easily irrigated by nearly rivers, then papyrus would easily replace forest trees as the main supplier for paper pulp.

Now Dr. Ragab is starting an experimental plot in the High Dam Lake

which he will cultivate with Cyperus papyrus. He has great hopes that his experimental work with papyrus ·ould led to very encouraging results. If this materializes then we have every hope that papyrus may come back to occupy the throne of paper industry which it had left to wood trees for more than one thousand year.

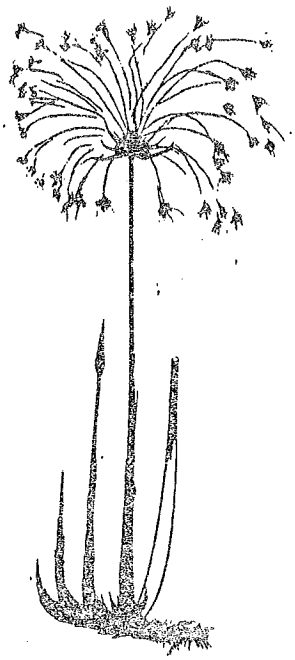


Fig. 1

Fig. 1

Fig. 2

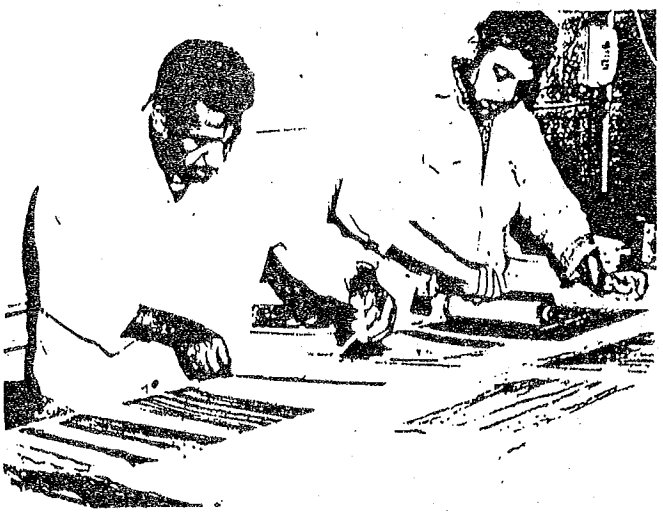


Fig. 3

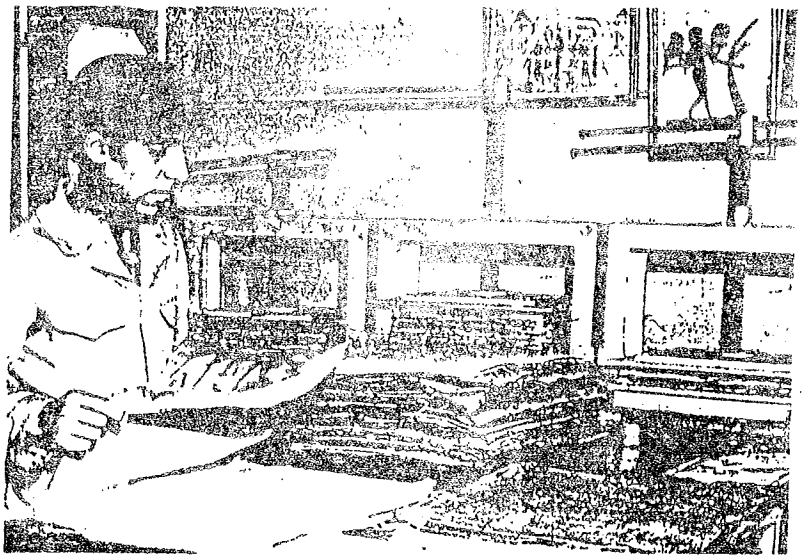
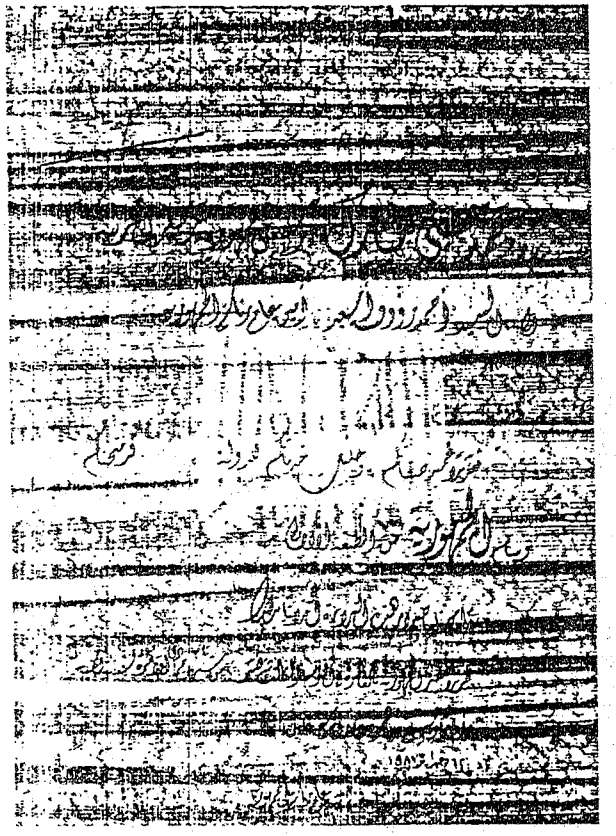
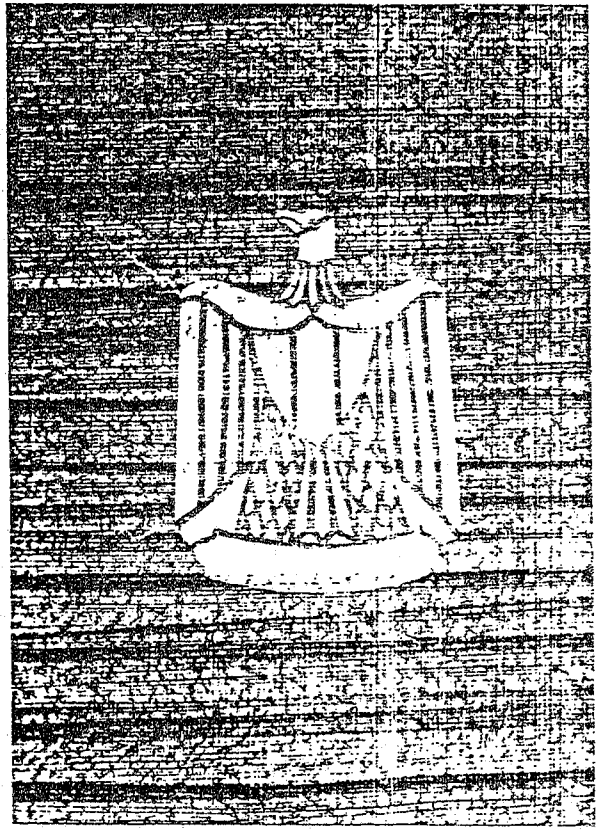
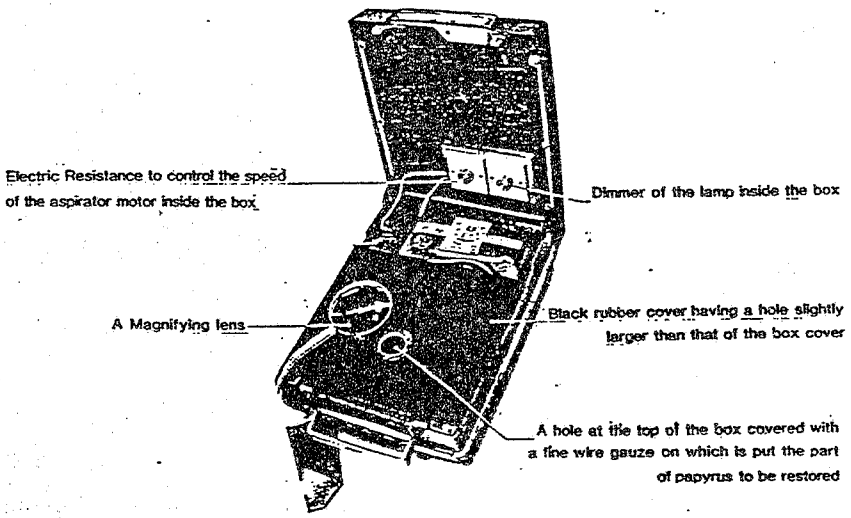


Fig. 4

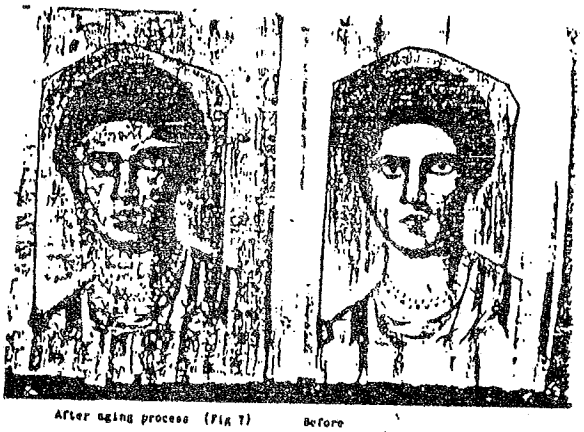




(Fig. 5)



(Fig. 6) Apparatus for the restoration of Papyrus sheets
Designed by Dr. Hassan Ragab



After aging process (Fig 7) Before

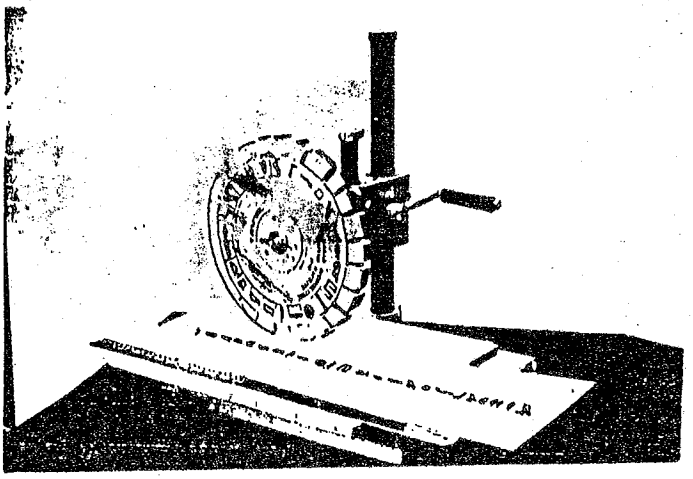


Fig. 8.

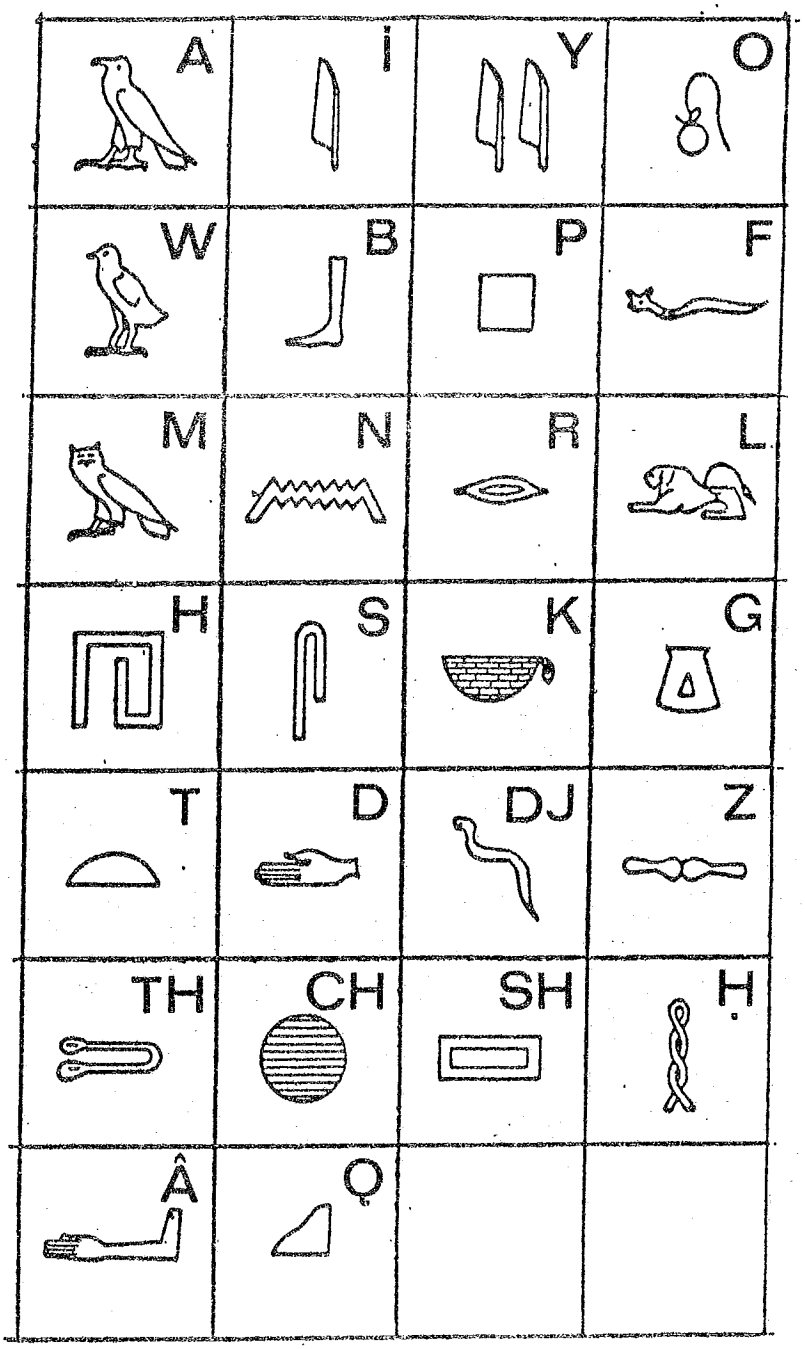
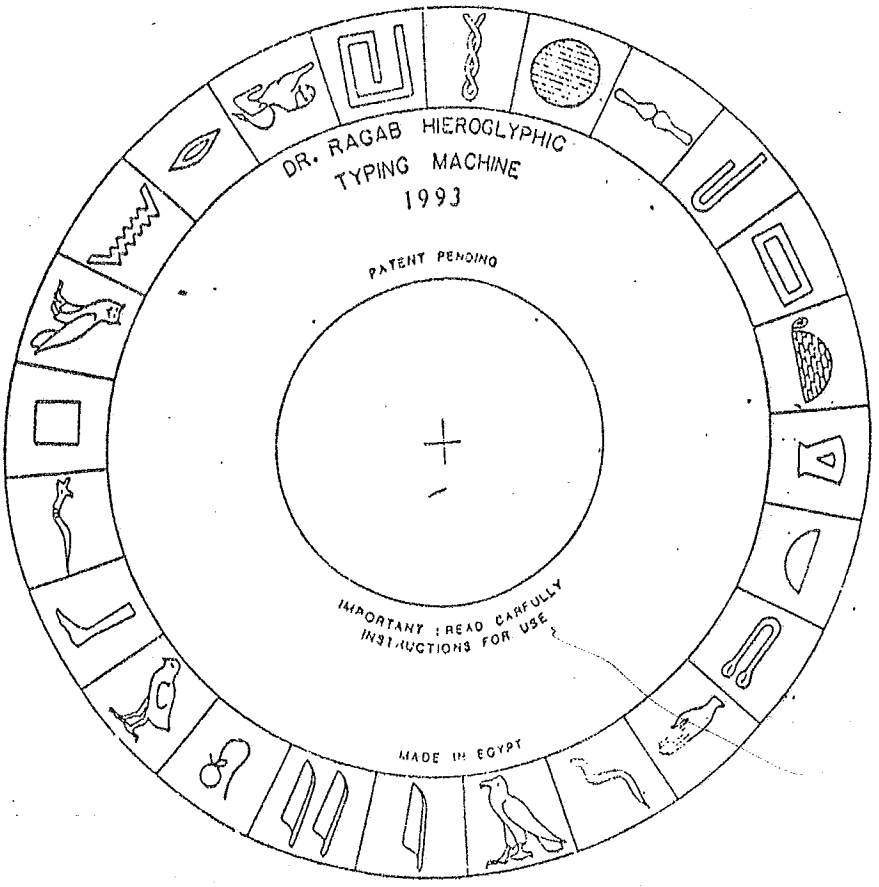


Fig. 9


DR. RAGAB HIEROGLYPHIC
TYPING MACHINE
1993
PATENT PENDING
IMPORTANT : READ CARFULLY
INSTRUCTIONS FOR USE
MADE IN EGYPT

(Fig 10)