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Report on visit to Dr.Baumgartner, Afif, Zürich.

Tuesday, 21st January 1958.

Purpose.

The purpose of the visit was to investigate the possibilities to obtain special photomultipliers from Dr.Baumgartner's group, either for special purpose, where no commercial photomultipliers are suitable, or for very fast work where we had up to now to rely entirely on the development at RCA, which is completely outside our control.

General information.

Professor Baumann, the director of "Afif", the "Abteilung für industrielle Forschung" of the physical institute of the ETH, explained to us the organisation and resources of the institute. "Afif" is run and financed by an association, the "Verein für Förderung der Forschung der ETH" of which the confederation, some of the cantons, the town Zürich, and some industries are members. The members contribute an annual budget. As this budget only covers general expenses, the institute can only take on research projects for outside firms and institutes on a cost basis. Overheads are however small since laboratories and administration are provided for by the ETH.

The present size of the group is about 70, divided in groups for electronic optics, solid state, electronics, semi-conductor materials.

Photomultiplier development.

CERN's interest in photomultipliers was welcomed since this work had suffered from lack of interest in the Swiss industry. The photomultiplier development is being done by Dr. Baumgartner, who is in charge of the group for solid state physics with a group of 8. Dr.Baumgartner has been engaged in this activity since 1949, initially under Dr. Schaetti, but since 1953 as the leader of the group.

Many different types have been made, some in numbers up to 100. At present under development is a 13 cm tube with plane outer, curved inner photocathode surface, so as to decrease the transit time spread.

All types have copper beryllium dynodes, rather than the silver-magesium dynodes used in commercial tubes. This preference is due to the availability and easier handling of this material. The lower efficiency will however necessitate a somewhat higher dynode voltage. A 14 electrode tube requires 3000 volts to give an amplification of 10^7. Antimony-cesium cathodds are usually used, although for infrared applications other photocathodes have been made. Tubes with quartz windows can be made.

The manufacturing of a tube with minor modifications from an already developped type, requires 2-3 days. Only after testing after a storage time of 2-3 months can the tube however be considered safe for use.

On our question whether "Afif" would be prepared to cooperate with CERN in the development of new photomultipliers of for example the fast type, CERN contributing the theoretical and experimental investigations leading up to the general design of the electron optical system, and "Afif" the practical design and the manufacturing know - how professor Baumann and Dr.Baumgartner agreed that they would welcome such a cooperation. Baumgartner estimated that the production of a test model which does not differ too much from established types photomultipliers would be charged about 1.000 - 2.000 Frs. This is comparable with the price of commercial RCA photomultipliers. We invited Dr.Baumgartner to come and visite CERN in order to get acquainted with our problems.

Once a type has been developped, "Afif" would be prepared to produce the type in small series. The production facility is for one photomultiplier of an established type in 1-2 days. The laboratories for photomultiplier production were well planned and the technical know-how impressive. We got the impression that the group has gone about the problem in a very serious and methodical way.

Other activities.

We visited the laboratories for electronic optics of Dr.Bas. An electron emission microscope with a magnification of about 4000 allowed the study of diffusion and recrystallisation phenomena in metals like molybdenum at high temperature. An electron optical bench with facilities for moving the elements from outside the vacuum chamber seemed very convenient for setting up electron optical systems. This apparatus showed an impressive standard of mechanical workmanship. Other investigations, involving the production and measurement of very high vacua, down to 10^{-9} cmm Hg, aim at the study of electron emission.

Dr. Baumgartner has also been doing work on image converters, particularly for the infrared, and might be a good man to discuss problems concerned with the luminescence chamber. He also seems to be familiar with electroluminescence and other solid state phenomena.

Conclusion.

Without yet having investigated other possibilities, such as commercial firms, it seems to us that the existence of Dr.Baumgartner and his group in Zürich offers a first class opportunity for CERN to get away with the technical difficulties in the development and production of new or special types of photomultipliers. To develop very fast photomultipliers we would on our side have to take care of the theoretical and experimental studies of the electron optical system, involving calculation of orbits and transit times, and farming out electrolytic tank measurements.

One important point is that it would not be required of us to commit ourselves to any great extent from the beginning. At any point of the development we may reconsider the matter and interrupt the cooperation. It is probable that in the case of commercial firms a substantially more rigid commitment would be necessary.

G.von Dardel, G.Fidecaro, A.Merrison.