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X-RAY CRYSTALLOGRAPHY IN GERMANY & AUSTRIA, WITH SPECIAL REFERENCE TO MINERALOGY

BRITISH INTELLIGENCE OBJECTIVES SUB-COMMITTEE

X-RAY CRYSTALLOGRAPHY IN GERMANY AND AUSTRIA, WITH SPECIAL REFERENCE TO MINERALOGY

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X-ray crystallography in Germany and Austria, with special reference to mineralogy.

Introduction

Our team was asked to investigate and report on X-ray apparatus and techniques, and the problems which had engaged German and Austrian crystallographers during the war years. X-ray investigations on minerals were to be our particular interest. This proved to be the correct approach as far as Germany is concerned in order to gain as wide a knowledge of the science and its numerous applications as was possible in the time at our disposal. For, whereas in England X-ray crystallography branched from physics, its development in Germany has been more closely associated with mineralogy. Also, Germany is endowed, despite war damage, with numerous well-equipped mineralogical institutes, one or two of which possess more and better apparatus than any mineralogical department in this country, whilst the humblest of the German institutes possesses X-ray apparatus superior in quality to that still tolerated in more famous English laboratories.

The growth of X-ray crystallography continuously widens the interests of German mineralogists and this is reflected in the variety of the problems on which they are, or have been, working. We have not, therefore, restricted ourselves to X-ray investigations on minerals only. Other investigators have, however, already reported on German X-ray work on metals and no attempt has, therefore, been made to deal with that subject adequately. Our special interest in minerals led us to visit many mineral collections and to inspect physical apparatus and study techniques employed side by side with X-ray

methods.

Equipment. Section 1. X-ray tubes.

Most of the laboratories we visited make use of sealed-off tubes and we were able fortunately to inspect the two plants in Germany which are the only ones producing this type for crystallographic work.

(a) C.H. Müller, Hamburg (Herr Weigle, Dr. Fehr). C9/403, C21/744

This firm, a subsidiary of Philips, produces the well-known 'Metalix' tube and had in March, 1946, sufficient raw material to make 100 at the rate of 25 per month. These are fine-focus tubes with two Lindemann glass windows and, according to the nature of the target, they are rated at 500 - 800 watt input.

Target	Fe Co Cr	Cu Mo W
Input	500	800

During our stay in Hamburg we learnt that, although policy and shortage of raw materials restricted the production of high vacuum equipment and products, the utmost encouragement was being extended to Müller's to manufacture X-ray tubes for medical work inside Germany and that a licence for export could be obtained only for the deep therapy tubes which are not made in Great Britain.

We cannot emphasise too strongly that both industrial and university laboratories in this country have been deprived throughout the war and since of sealed-off X-ray tubes. They are not manufactured here and although there is no dearth of plans for home production, these are at such an early stage that a long delay is inevitable. Meanwhile, research in X-ray crystallography, particularly fundamental research, is seriously

handicapped. It is particularly galling to pass from one German university to another and find Müller's tubes in use and Müller's still supplying X-ray tubes, admittedly in small numbers, for crystallographic work inside Germany.

As an interim modification of policy we recommend, therefore, that a large proportion of Müller's present output (25 per month) be sent to this country. It is essential that immediate action should be given to our 'T' force order for 25 Müller tubes. If work in this subject is to proceed at once then it is obvious that during the period of many months which must elapse before British X-ray diffraction tubes are in production X-ray tubes of foreign manufacture must be imported.

(b) Siemen's, Erlangen (Dr. Wolfel). C9/936, C21/1794

X-ray tubes for diffraction work are not now in production but we are informed that they probably would be in two or three months from the time of our visit (April 15th). This firm has manufactured both round focus and line focus tubes for work on crystals, these, of course, being provided with targets of various metals. The anode is hooded with beryllium to prevent electrons bombarding the glass and damaging the tube. Two sizes are made with three or four windows respectively and can be run at 20 milliamps.

(c) Continuously evacuated demountable tubes are used in Germany but are not now in production.

Dr. H. Seemann of Konstanz, formerly of Freiburg, showed us one with accessory backing and high vacuum oil diffusion pumps. Selmayr of Haar, formerly of Munich, made the Ott tube but we saw none of his design complete or in operation.

(d) Gas tubes are very little used in Germany. They require frequent dismantling and service if the emission of X-rays is to be maintained at a high standard. This no doubt is the chief reason why the continental research worker no longer uses them. Two Hadding gas tubes with copper targets are, however, employed in addition to sealed-off tubes in Correns' Mineralogical Institute in Göttingen. C21/1795, C9/1156.

Section 2. High voltage equipment.

(a) The compact transformer units 'Micro 60' manufactured by Müller's of Hamburg for use with the 'Metalix' tubes possess a novel feature which places them ahead of any high voltage equipment for crystallographic work in this country. The transformer unit itself is water-cooled and makes possible the use of smaller gauge windings and, therefore, a considerable reduction in overall size.

Müller's had ten complete units in stock in March of this year and additional units not yet completed owing to the shortage of porcelain or equivalent material for insulation of the high voltage terminal.

(b) * Seifert's, also of Hamburg, markets an efficient equipment (not water-cooled) which can be used with Müller, Siemen or gas tubes.
* 9/147, C21/1796.

Both Müller's and Seifert's high voltage units were seen in use in various laboratories and, in addition, some sets of older design.

German X-ray workers were, on the whole, fortunate in being able to purchase the best equipment available at the time and this is particularly true of the high voltage and

control equipment in their X-ray sets.

Section 3. X-ray diffraction cameras.

Both Müller's and Seifert's of Hamburg market the usual type of powder and back reflection cameras which call for no special comment. Müller's also make a stress camera in which the photographic plate oscillates in its own plane. Neither firm considers that the production of such apparatus can be resumed in less than a year. Seifert's have also manufactured a camera with a Geiger-counter self-recording device but this can no longer be produced until a new source of Geiger counters is available. Presumably this apparatus resembles that recently marketed by Philips' (America) in London.

No one who has seen the various X-ray cameras and goniometers manufactured by Seemann has failed to comment on their superb quality. Nearly all this type of equipment is small and compact but quite often of complex design so that expert craftsmen and precision lathes and tools are essential for their production.

Dr. Hugo Seemann lost most of his pre-war equipment in Freiburg and is now striving with his wife, son and one assistant to produce the simpler items of his catalogue in Konstanz where he now has an office in Rheingutstrasse 6. His workshop and laboratory address is Zaseustrasse 8. We were fortunately able to spend a second day with Seemann who unpacked complete instruments successfully evacuated from Freiburg for our inspection. The following equipment was examined:-

		Pre-war price in marks
(1)	Powder camera (57.3 mm. diameter) with motor.	800
(2)	Single crystal rotation, oscillation and powder camera.	1200
(3)	Universal camera for Laue, Schiebold and rotation photographs.	3500
	An additional cylindrical 'Serien' camera to take 10 successive crystal or powder photographs.	1700
(4)	High temperature water-cooled powder camera diameter 114.6 mm. to take 5 successive powder photographs.	4000-5000
(5)	Weissenberg moving film camera.	6000

Seemann was of opinion that he could produce items (1), (2) and (3) within a reasonable time and the auxiliary 'Serien' camera for (3) within three months. He emphasised, however, that he would be quite incapable of making (4) and (5) until he has more machines.

We have already made separate application during the writing of this report for a competent crystallographer and instrument-maker to visit Seemann to copy his drawings or, if they cannot be found, to draw and photograph the various cameras we detailed above. This we consider to be a more efficient method of obtaining apparatus of the Seemann quality for our laboratories than placing orders in the French zone where raw materials and