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Country: Sweden/Netherlands/Denmark/Germany

Subject: Some European Nuclear Energy Research Centers

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Source: US citizen, PhD, professor of physics at a well-known US university. In addition to teaching, he is working under contract to the US military establishment in the field of solid state physics. In touring various European research institutes in the fall of 1952 he came in contact with the following nuclear research centers:

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SWEDEN

<u>Division of Electronics at the Royal Institute of Technology (Kungl Tekniska Hogskolan - KTH), Stockholm</u> - 13 Sep 52

1. At the Royal Institute of Technology I visited several groups or departments including the Division of Physics I (there are two) under Professor G. <u>Borelius</u>, the Division of Applied Mathematics II (Mathematical Physics) under Professor Lamek <u>Hulther</u>, and the Division of Electronics under Professor Hannes <u>Alfren</u>.

2. In the Division of Electronics, the motion of charged particles in electric and magnetic fields are being studied. Two synchrontrons have been built, 35Mev and 70Mev.

3. The model experiments on aurora discharge are very ingeneous. A large metal chamber a couple of feet in diameter and several feet long with a heavy glass window at one end is used as a discharge chamber. Magnetic fields can be applied in a variety of ways and equipment to handle heavy discharge currents for a few seconds is available so that discharges can be set up which look the way aurora discharges do. I feel that progress in understanding the aurora will come much faster with this type of investigation than by extensive observation of the natural aurora. An idea for a new type of accelerator is being worked on and while the scheme had not been made to work when I visited the laboratory I believe the idea is a good one. Imagine a long narrow plane cathode surface. Accelerating electrodes accelerate and focus the electron streams at a distance a few inches from the plane of the cathode. Between the cathode and the focal line there is a wave guide system which with the travelling wave present

should cause the beam to bunch or accumulate groups of electrons along the long axis or focal line. Since the wave is travelling these bunches of electrons should appear to move along the focal line since the electron charge density at any point along the focal line will rise and fall with time. Imagine now a stream of protons directed along the focal line. The negative space charge bunches will attract the protons and the negative charge bunches will appear to move as a travelling wave and so accelerate the protons. It is of course not an easy task to make such a device work, but it does look possible.

The Swedish Atomic Energy Co., Stockholm - 13 Sep 52

4. I talked with Dr. S. Eklund who is head of the Physics Laboratory of the Atomic Energy Company. The program of work is at present directed mainly at getting the reactor built and operating. There is some work directed at the study of neutron diffusion especially in graphite. I talked at length with Dr. G. Von Dardel about the neutron work.

5. At present /September 1952/ the excavation of the region which will house the reactor is underway. The reactor building will be set in solid rock extending a hundred feet below the surface. Much of the excavation is complete but the actual building is not yet started /15 Sep 52/. It is estimated that the building and the reactor will be completed in one and a quarter to one and a half years. I doubt that both things can be done in this amount of time.

6. Most of the time which I spent at the Atomic Energy Laboratory was in talking with Dr. G. Von Dardel about neutron diffusion in carbon. I was not particularly impressed with the equipment employed. One type of experiment which they are now doing is that of bombarding a target with 150 kw protons to obtain neutrons. Neutrons are produced in a block of graphite. Protons are sent into the target in two to four micro-second pulses so that the neutrons are then also sent out from the target in pulses. The response of a detector to the burst of neutrons arriving at the outside of the graphite is then taken as a function of time. This work, of course, involves a neutron spectrometer which is described in Swedish Arkiv För Fysik Bd 5 # 8 page 121.

7. The energy of the neutrons in question is one electron volt and less. The distribution of velocities in the original burst of neutrons is not known.

8. The ion source is a modified Werner type and supplies only 100 - 200 microamperes of protons. The source is unimpressive as regards the amount of protons supplied but it is quite compact.

9. A two megavolt Van dé Graff is present but apparently under repair most of the time. The machine would be used for experiments similar to the above if it were not so clumsy to use.

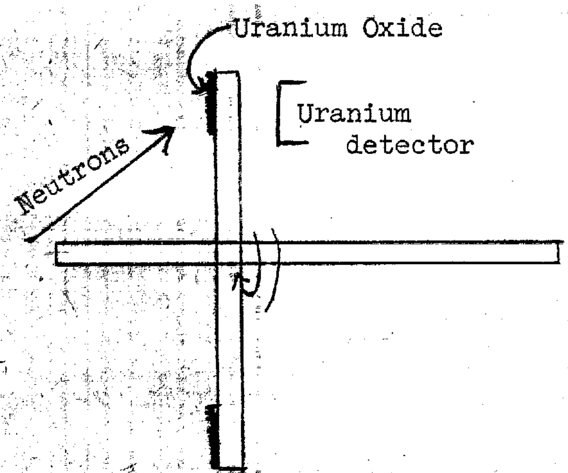
10. In addition to the neutron diffusion experiments work on dosage meters and health physics is also planned and underway. The present group is

only a skeleton group which is to be expanded considerably when the reactor and other equipment are ready.

11. An exchange relationship is now in existence between North Carolina State and the Atomic Energy Co. - a man named Waltner from N. C. State is now working in Stockholm and one of the Atomic Energy Co. men is at N. C. State.

12. An experiment now planned but not yet performed is of interest and is as follows:

13.



Section Through Rotating Wheel

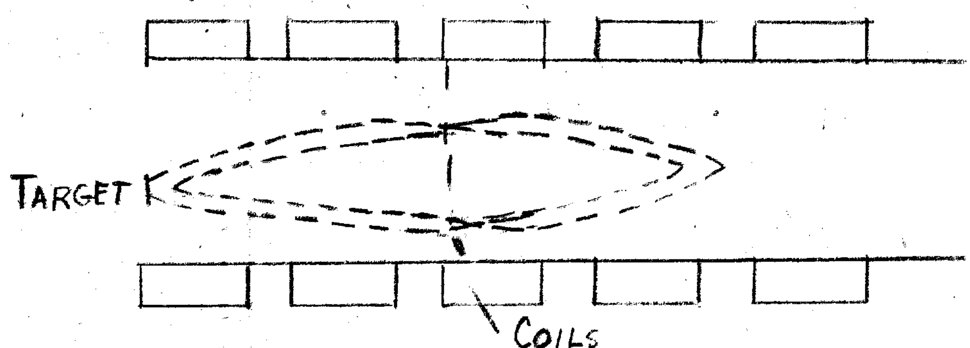
Consider the following experimental arrangement of an aluminum wheel with Uranium oxide powder glued to one side of the wheel as indicated. The wheel in question can be rotated very rapidly. Behind the wheel is a uranium detector for the neutrons penetrating the Uranium Oxide (and the wheel) to enter. Neutrons are incident at an angle (less than 90°) and normal to the radius of the wheel. There is a 6.6 electron volt resonance in Uranium.

This experiment will allow the measurement of the shape of the resonance curve.

Nobel Institute, Stockholm - 15 Sep 52

14. M. Siegbahn and Kai Sighbahn together with L. Hulthen showed me the β-ray spectrometer for precision analysis of the lines of such materials as thorium ThB where with this equipment line widths of F and J lines, for example, can be compared. The magnet is pulsed (few seconds) - the quantity $\frac{qH}{H}$ is very constant with deviation less than one part in 10^4 over a period of 500 days.

15. Another type of β-ray spectrometer is that with a double focus on a cylinder e.g.



In general the Nobel Institute is working on nuclear problems. The cyclotron (22 mev. deuterons) is in operating condition. It is a standard cyclotron of the older type. A nuclear spectrometer for heavy particles (energies and angular distributions) has been built. The spectrometer is a sector magnet of angle 180°. The source and the detector are outside the field gap. The magnet produces a 17,000 gauss field with a mean gap of about 5 cm.

16. A 1.5 Mev accelerator for heavy particles consists of a seven step cascade generator with an R.F. ion source. A 90° deflecting magnet is the analyzer (r=40 cm.)

THE NETHERLANDS

Philips of Eindhoven - 26 Sep 52

17. In the field of nuclear physics Philips builds cyclotrons and betatrons to order. They have built the 28 m.e.v. dueteron cyclotron now in the Institute of Nuclear Physics at Amsterdam. Philips is concerned mainly with instrumentation in the field of nuclear physics - counters, photo devices, multipliers etc.

DENMARK

Institute for Theoretical Physics (Niels Bohr's Institute)

18. I with Dr. Koch of this institute, found that while it is known as an institute for theoretical physics it is rapidly becoming more of an experimental facility for nuclear research. A large cyclotron is underway but still in early stages. Mass spectroscopy appears to be the main experimental effort at present. I did not see anything sufficiently new

and different to investigate further.

GERMANY

Max Planck Institute - 15 Nov 52

19. I visited the Max Planck Institute in Gottingen for a few hours. Dr. W. Heisenberg talked with me about conditions in Germany in general and the institute in particular. We had previously met when Heisenberg visited the US about two years ago. The Physics part of the Max Planck Institute is devoted entirely to nuclear problems--problems concerned with cosmic rays and cloud chambers for cosmic ray work. Related work on photographic detection and counters is also underway. A microscope of very elaborate and expensive construction built by Zeiss especially for following cosmic ray tracks in emulsions and for measuring very small angles on these cosmic ray tracks was given to Heisenberg as a birthday present. The equipment and buildings in the Institute seem to be new and in excellent condition.

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