(AFTER-SKI ON OWN RESPONSIBILITY)

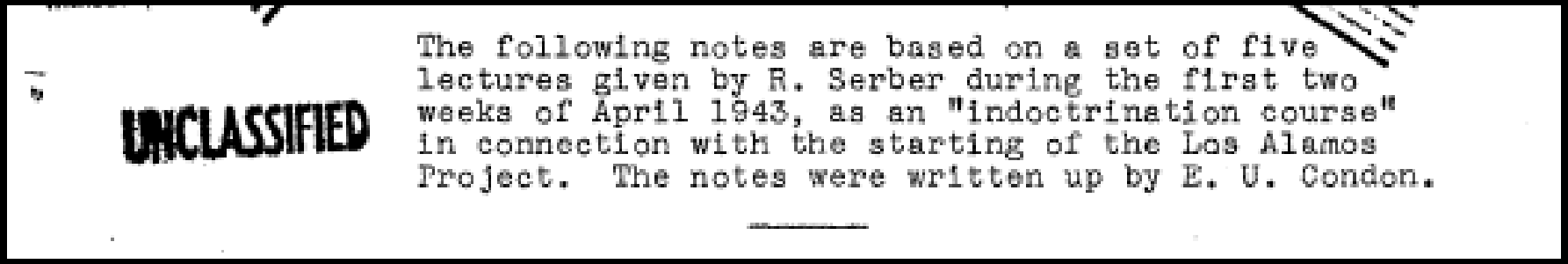
FINSE 2011

Tor Hjalmar Johannessen

SECURITY IS SO MUCH-
(AND WHAT DO WE NOT FIND ON THE WEB?

- Much happened back in 1943….e.g,.Serber Lecture Notes

The socalled Serber lecture notes have later been declassisfied….



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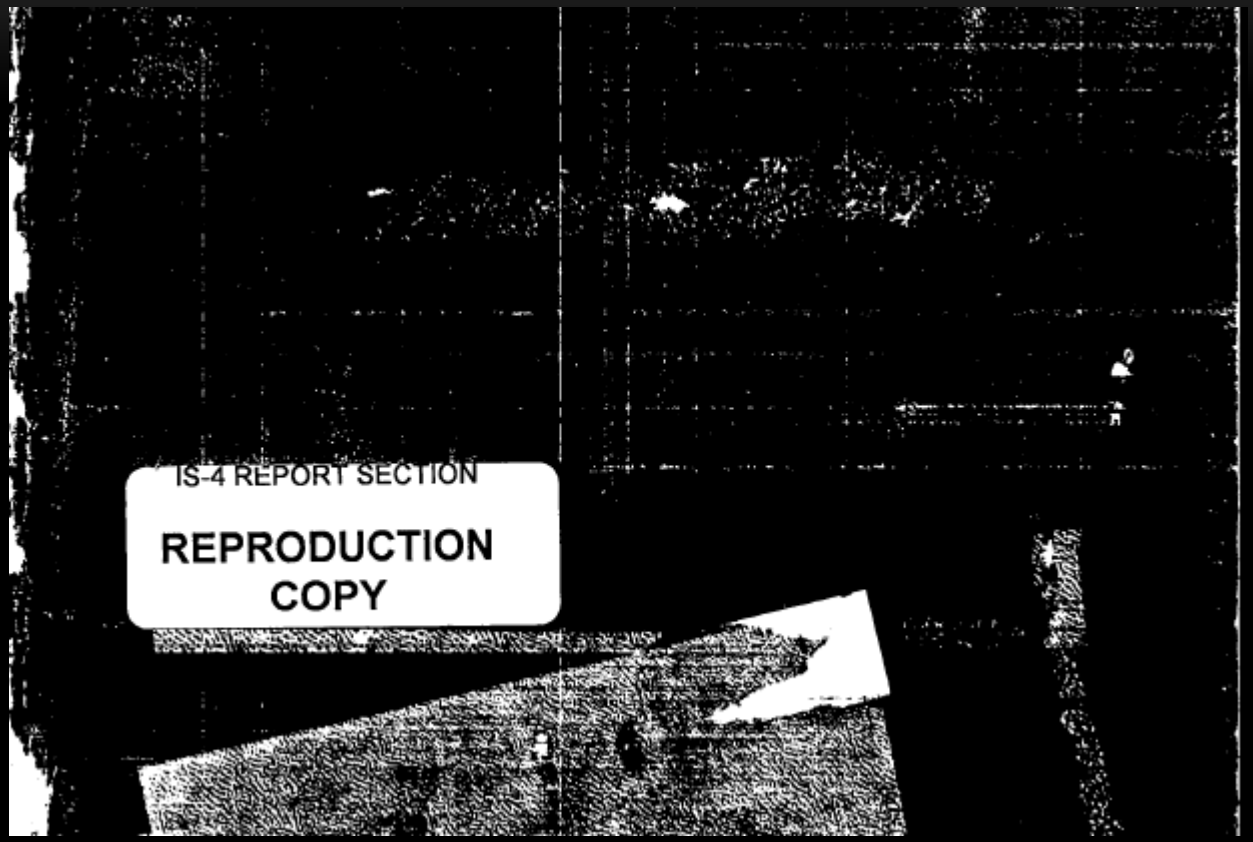
The following notes are based on a set of five lectures given by R. Serber during the first two weeks of April 1943, as an "indoctrination course" in connection with the starting of the Los Alamos Project. The notes were written up by E. U. Condon.

Robert (Bob) Serber is reckoned one of the star sudents of R. Oppenheimer.

FAXIMILE



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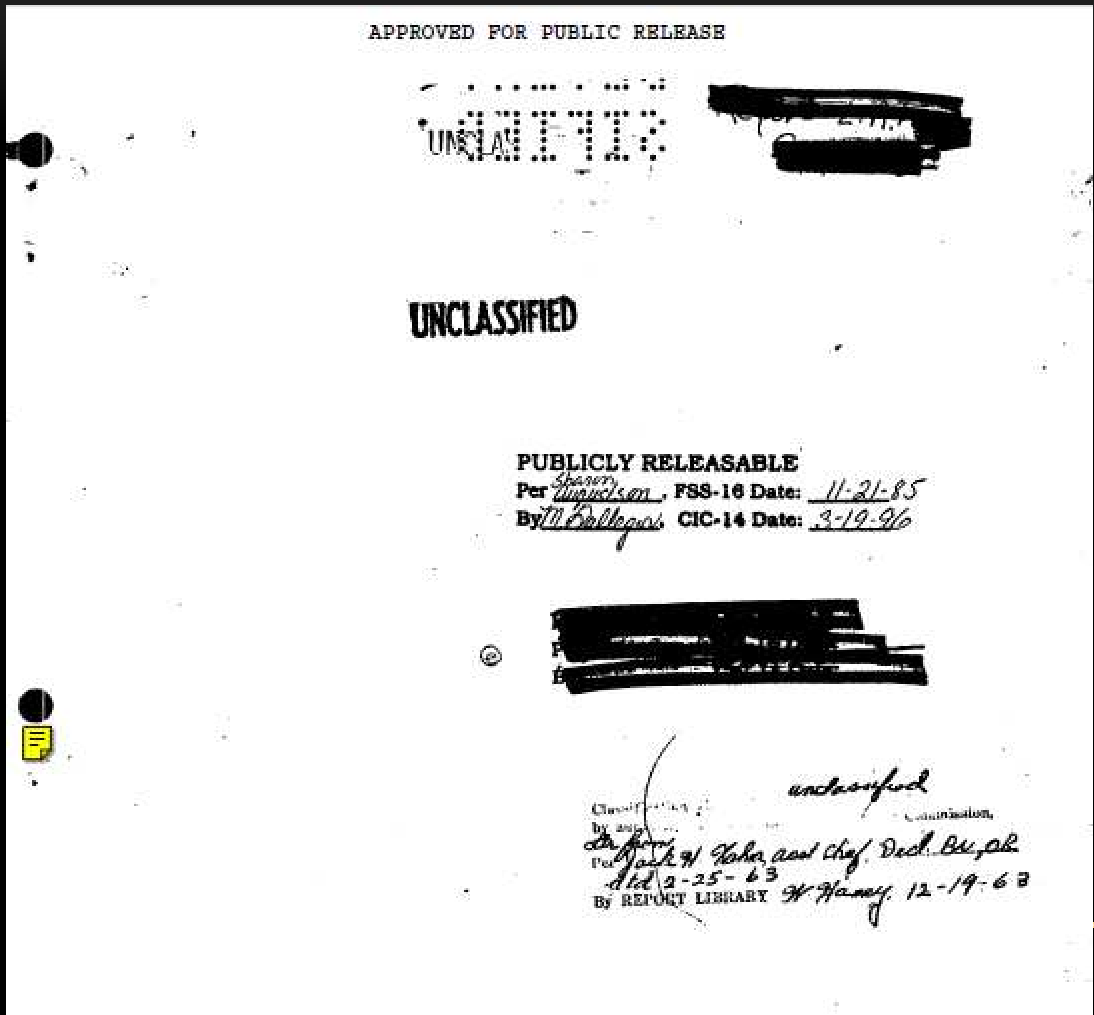

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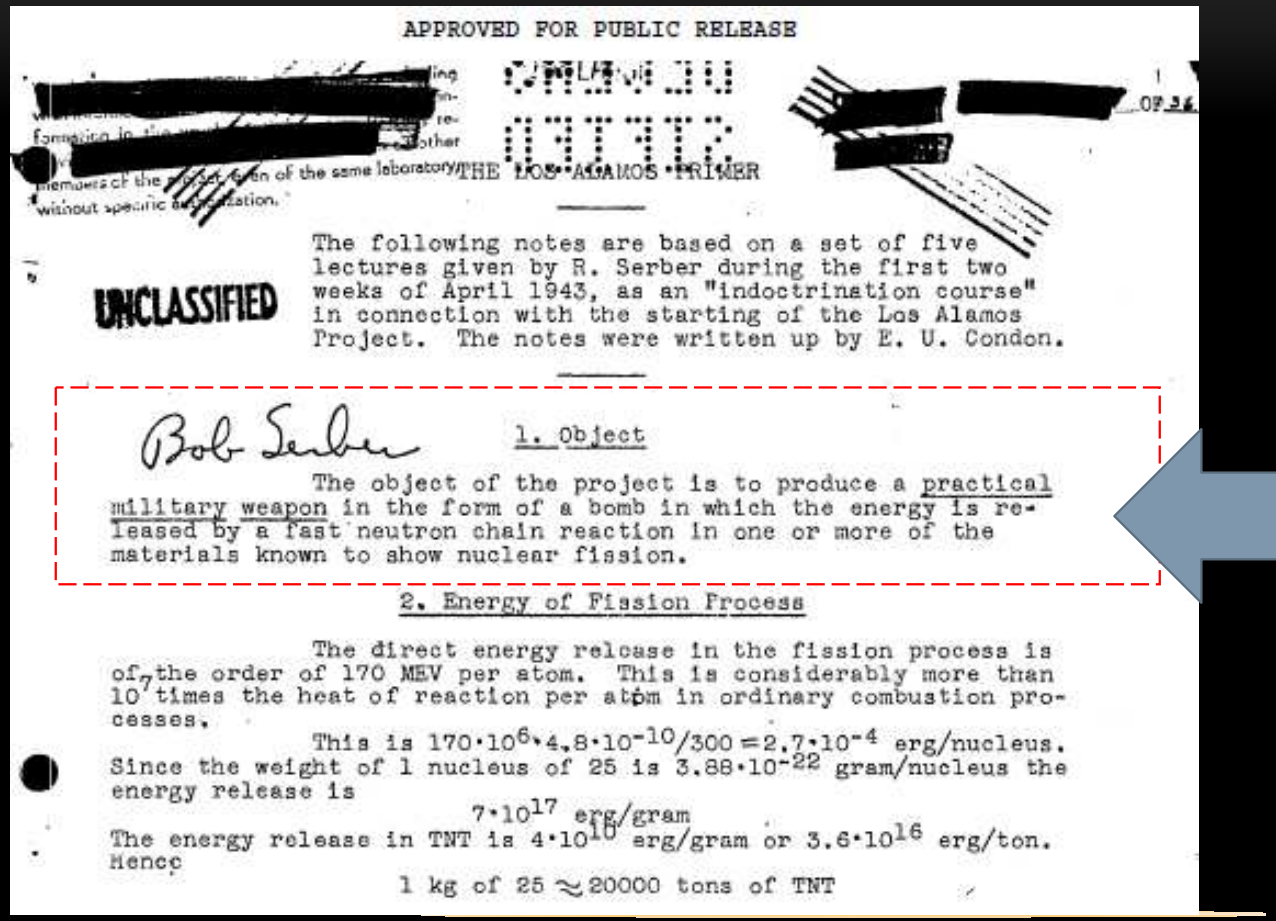
Totallly 26 pages

AMONG ALL LECTURES IN ALL TIMES:
- NONE SUPERIOR OR ALIKE ! & !



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members of the project [redacted] of the same laboratory without specific authorization.

THE LOS ALAMOS PRIMER

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Bob Serber

1. Object

The object of the project is to produce a practical military weapon in the form of a bomb in which the energy is released by a fast neutron chain reaction in one or more of the materials known to show nuclear fission.

2. Energy of Fission Process

The direct energy release in the fission process is of the order of 170 MEV per atom. This is considerably more than 10^7 times the heat of reaction per atom in ordinary combustion processes.

This is $170 \cdot 10^6 \cdot 4.8 \cdot 10^{-10} / 300 = 2.7 \cdot 10^{-4}$ erg/nucleus. Since the weight of 1 nucleus of 25 is $3.88 \cdot 10^{-22}$ gram/nucleus the energy release is

$7 \cdot 10^{17}$ erg/gram

The energy release in TNT is $4 \cdot 10^{10}$ erg/gram or $3.6 \cdot 10^{16}$ erg/ton. Hence

1 kg of 25 $\approx$ 20000 tons of TNT

Four lines indicating what changed the world
- Simple and easy

- MANY CALCULATIONS

- Critical Mass
- Neutron Flux
- Neutron spectrum

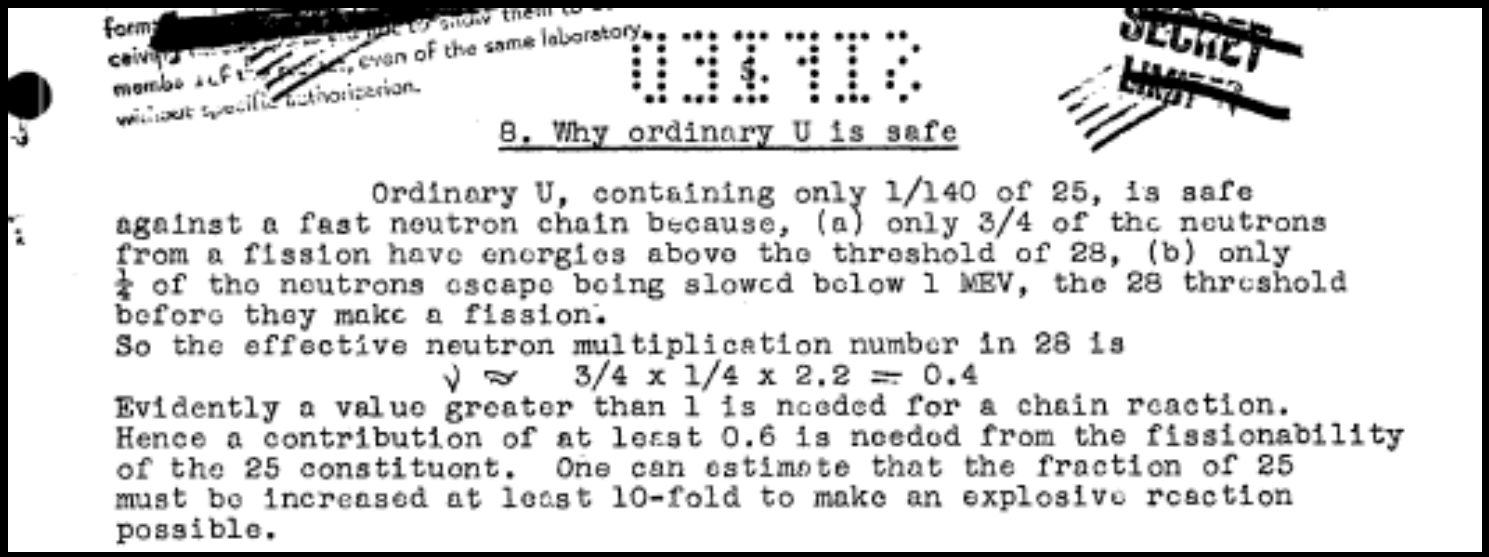
- Serber uses «to Fish» to express fission process (!)

Since in 1 kg. of 25 there are $5 \cdot 10^{25}$ nuclei it would require about n = 80 generations ($2^{80} \approx 5 \cdot 10^{25}$) to fish the whole kilogram.

While this is going on the energy release is making the material very hot, developing great pressure and hence tending to cause an exposion.

Dangerous Misspelling?

A LITTLE SECURITY SHOULD BE IN PLACE TO AVOID CONCERNS…



[redacted] even of the same laboratory.

SECRET

8. Why ordinary U is safe

Ordinary U, containing only 1/140 of 25, is safe against a fast neutron chain because, (a) only 3/4 of the neutrons from a fission have energies above the threshold of 28, (b) only ½ of the neutrons escape being slowed below 1 MEV, the 28 threshold before they make a fission.
So the effective neutron multiplication number in 28 is

$$\nu \approx 3/4 \times 1/4 \times 2.2 = 0.4$$

Evidently a value greater than 1 is needed for a chain reaction. Hence a contribution of at least 0.6 is needed from the fissionability of the 25 constituent. One can estimate that the fraction of 25 must be increased at least 10-fold to make an explosive reaction possible.

ON TIME TO MAKE SOME BANG….

- Section 15.

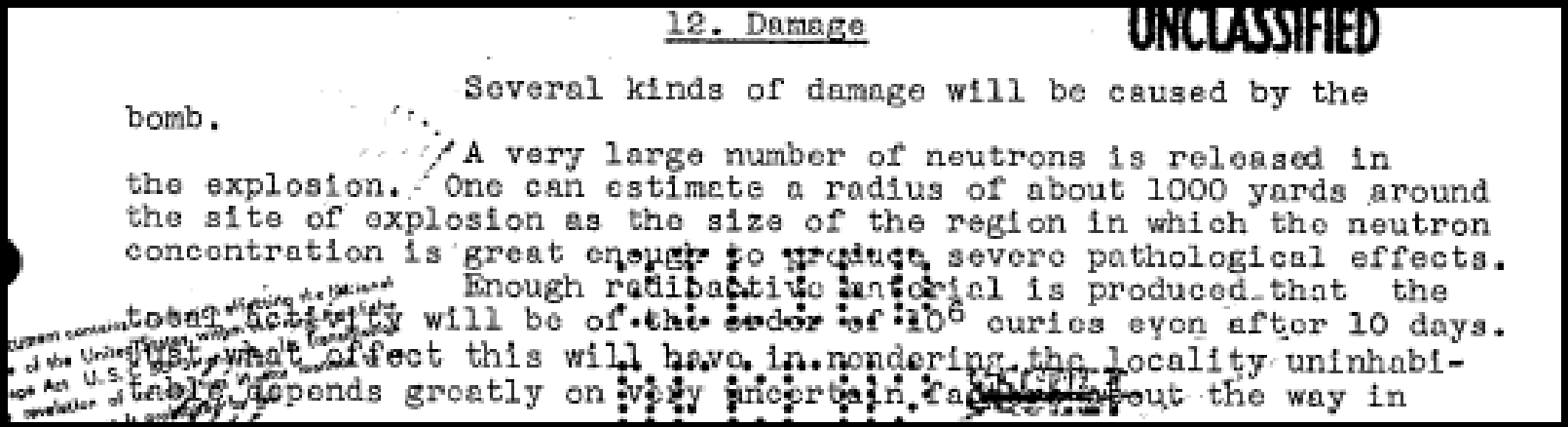
15. Detonation

the bomb together is $\sim 10^{-4}$ sec. Since the whole explosion is over in a time $\sim 75\ \tau/\nu' \approx 10^{-6}$ sec, we see that, except for very small ν' ($\nu' < \rho$), an explosion started by a premature neutron will be all finished before there is time for the pieces to move an appreciable distance. Thus if neutron multiplication happens to start before the pieces reach their final configuration an explosion will occur that is of lower efficiency corresponding to the lower value of ν' at the instant of explosion.

To avoid predetonation it is therefore necessary to keep the neutron background as low as possible and to effect the rearrangement as rapidly as possible.

…things can happen fast, better run really fast
or move away in due time

DAMAGE ASSESSSMENT
- ALSO AN IMPORTANT SECURITY ESTIMATOR



12. Damage

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Several kinds of damage will be caused by the bomb.

A very large number of neutrons is released in the explosion. One can estimate a radius of about 1000 yards around the site of explosion as the size of the region in which the neutron concentration is great enough to produce severe pathological effects. Enough radioactive material is produced that the [illegible] activity will be of the order of 10^6 curies even after 10 days. Just what effect this will have in rendering the locality uninhabitable depends greatly on very uncertain factors about the way in

Much bang per buck ?
-not to forget the radiation after-effects

MOST IMPORTANT SECURITY SECTION - RISK ANALYSIS

16. Probability of Predetonation

Since it will be clearly impossible to reduce the neutron background rigorously to zero, there will always be some chance of predetonation. In this section we try to see how great this chance is in order to see how this affects the firing prob-lem.

Bla.bla.bla….

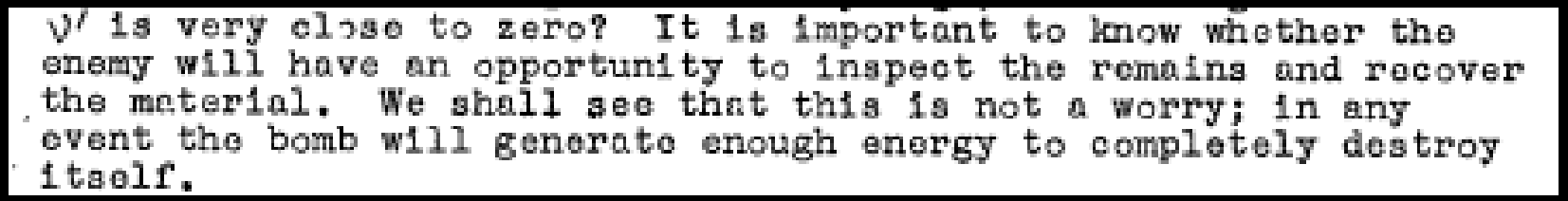
Since the efficiency varies as v'^3 one will get an explosion of less than $\frac{1}{4}$ of the maximum if it goes off before v' has reached the value $0.3/\sqrt[3]{4} = 0.19$. Hence the probability of an explosion giving less than 25% of the maximum value is

$(.19/.3)^2 \times .15 = 6\%$

Any volonteers to take the chance??

FURTHER SECURITY – CONFIDENTIALITY

IMAGINE RESIDUES OF THE BOMB SHOULD FALL IN THE HANDS OF THE ENEMY (AFTER EXPLOSION)



ψ' is very close to zero? It is important to know whether the enemy will have an opportunity to inspect the remains and recover the material. We shall see that this is not a worry; in any event the bomb will generate enough energy to completely destroy itself.

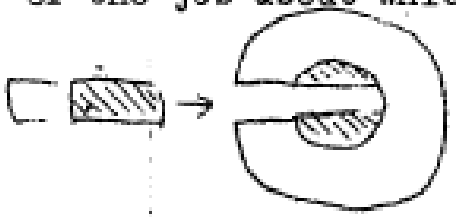
…relax; EVERYTHING vaporises.

FOR THE INTERESTED READER:
A FEW WELL KNOWN FIGURES:
- THE ORIGINAL SCHEMES!

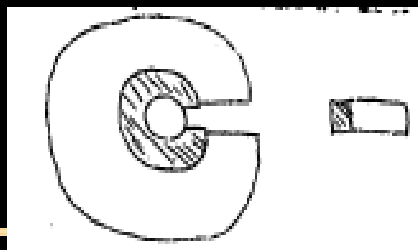
- To achieve critical mass(1)

20. Shooting

We now consider briefly the problem of the actual mechanics of shooting so that the pieces are brought together with a relativ velocity of the order of 10^5 cm/sec or more. This is the part of the job about which we know least at present.

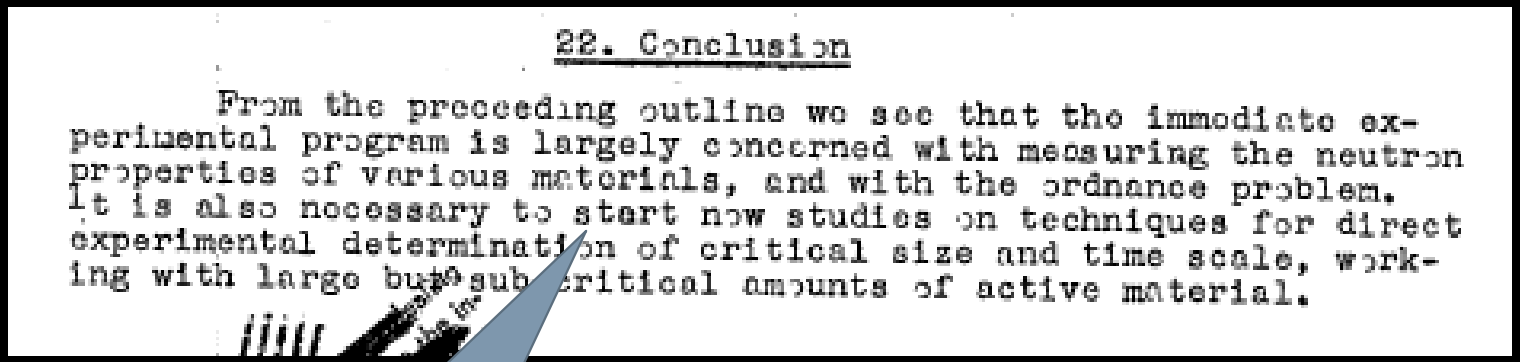


One way is to use a sphere and to shoot into it a cylindrical plug made of some active material and some tamper, as in the sketch. Th avoids fancy shapes and gives the most favorable shape,for shooting; to the projected piece whose mass would be of the order of 100 lbs.



The simplest schome which might be autocatalytic is indicated in the sketch where the active material is disposed in a hollow shell. Suppose that when the firing plug is in place one has just the critical mass for this config-

NO GOOD LECTURE WITHOUT CONCLUSION.



22. Conclusion

From the preceeding outline we see that the immediate experimental program is largely concerned with measuring the neutron properties of various materials, and with the ordnance problem. It is also necessary to start now studies on techniques for direct experimental determination of critical size and time scale, working with large but sub critical amounts of active material.

No scientific conclusion without requesting need for more research (and budgets)

The proof of the pudding is elsewise well-known:
66 years since Hiroshima this year.
Not necessarily something to celebrate.

CONSEQUENCES FOR NORWAY

- Post Hiroshima:
  1. Peace between the super powers, including Norway as a part of NATO.
     - The super powers threatened each other, but none ever dared to attack first any longer
  2. Late 1940-ies: the Farris mineral water source changed name from «Kong Haakon VII's *radioactive* well»
     to: «Kong Haakon VII's well»
  3. Farris mineral water company ceased to advertise the Farris drink to contain«radioactive elements» on the bottle label
     (ca 1949), but of course without changing the contents(!)
  4. - and in Norwegian vicinity… http://www.youtube.com/watch?v=-s8iie0zZ-g&annotation_id=annotation_848077&feature=iv

….AND FINALLY:
HAIL TO THE FARRIS DRINK

- & Thanks for for listening