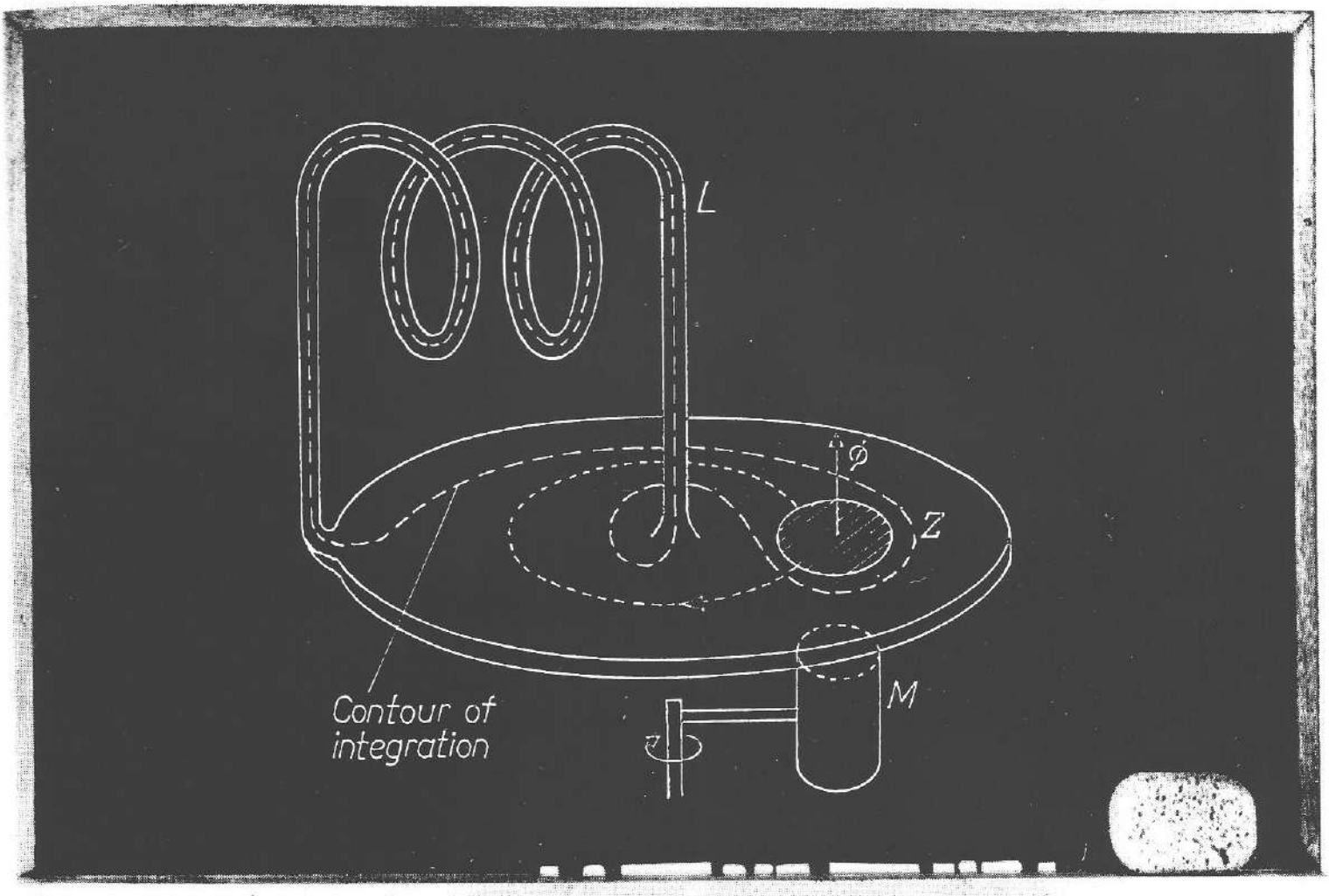

Current happenings in the cold

By Professor J. Volger

The future design of superconducting magnet coils may call for very heavy currents - well up into the kiloamp range. What then will become of the simplicity of the system? Whilst the coil should of course be at very low temperatures in its cryostat, will conventional current sources continue to be used? At room temperature! Just think of all the bother of heavy current leads, the enormous heat losses, the instabilities... My colleagues and I feel that the answer must lie in a fully superconducting current generator capable of producing very large currents - **within the cryostat.** The current generator or dynamo should thus make a closed superconducting circuit together with the coil. Now at first sight, this might seem as if we have excluded every essential effect necessary to the dynamo - because, basically, in a superconducting ring or loop the amount of magnetic flux enclosed is absolutely constant, and the possibility of some flux re-distribution within the loop wouldn't work miracles. However, the inclusion of the dynamo within the loop does in fact alter the topological nature of the closed circuit, making it a triply connected body. This allows a very interesting degree of freedom. The dynamo has a thin superconducting plate through which a certain amount of magnetic flux is passing. The zone where this flux passes is in fact the second "hole" in the topological structure of the superconducting system in its totality - i.e. dynamo plus magnet. It is not covering the whole plate, of course, since a sufficiently large area has to be left undisturbed to accommodate the produced supercurrent. By applying an auxiliary external magnetic field, varying in space and time so as to make it essentially rotatory, a continuous guided flux transport is achieved. And although the zone in the dynamo plate and the flux packet it contains, are moving periodically, the result is a monotonous increase of field in the coil! Any suspected violation of the law of conservation of magnetic flux is only apparent depending on the choice of integration contour defining the flux to be preserved. Using a simple set up of this type consisting of a lead plate soldered to a NbZr.coil, we have already produced currents of more than 2000A! Did someone mention MHD?