

BOOKS

Gravity, by George Gamow (London, Heinemann Educational Books Ltd., 1962; 5 s.), is number 17 in the *Science Study Series* originated by the Physical Science Study Committee in the U.S.A. and published under the auspices of Educational Services Incorporated. The series aims to give students and the general public 'the writing of distinguished authors on the most stirring and fundamental topics of science, from the smallest known particles to the whole universe'. The primary purpose is to provide a survey of each particular topic within the grasp of this class of reader, although it is also hoped that the books will serve as an encouragement for their further investigation of natural phenomena.

This volume is written (and illustrated!) by a theoretical physicist who is one of the foremost interpreters of science to the layman, creator of the famous Mr. Tomkins a quarter of a century ago. As might be expected, it is clearly written, interesting, and instructive. Dealing with a subject that is more 'fundamental' than 'stirring', at least at the present time, it should nonetheless encourage many readers to search for further information, whether it be of a historical or a scientific nature.

The story in fact follows historical progress in explaining the current theoretical ideas on the nature of gravity, dealing, as Gamow says, with the three great names in the history of man's understanding of gravity: Galileo Galilei, Isaac Newton, and Albert Einstein. Six of the book's ten chapters deal with the Newtonian theory of universal gravitation, since this must remain the basis of any modern refinement.

In discussing Galileo's experiments on falling bodies and his formulation of the mathematical relations describing free fall, the ideas of vectors and vector addition are easily introduced, and this leads naturally to Newton's reasoning that a body moving fast enough above the earth would never fall to the ground but continuously circle around our spherical planet like the moon (or a modern satellite). The logical development from these first thoughts to the theory of universal gravitation — that there is an attractive force between any two bodies proportional to the product of their masses and inversely proportional to the square of their distance apart — is then followed through, after which there is a pause of one chapter whilst the basic principles of the infinitesimal calculus are explained.

One of the interesting things about Newton's theory is that its publication was held back for some twenty years whilst its author developed the mathematical methods necessary for its proper formulation. The differential and integral calculus that resulted is now an essential part of physics, and Gamow makes no excuses for including a discussion of it in this book. 'Those who are frightened by mathematical formulas can skip that chapter', he says, 'but if you want to learn physics, *please do try* to understand Chapter 3.'

Succeeding chapters deal expertly with Newton's proof of Kepler's laws, the phenomenon of precession, and the cause

of the tides. In the latter case, one is reminded that tidal friction gradually slows down the earth's rotation (so that a day is now 0.0007 second longer than it was century ago and the century 14 seconds longer than it would otherwise have been) and that the conservation of angular momentum in consequence pushes the moon into orbits of steadily increasing radius.

Some of the triumphs of celestial mechanics are then recounted — the prediction of the planet Uranus and later of Pluto, the calculation of the dates of eclipses (as a result of which it appears that this year is in fact AD 1969!), and the perturbations of the earth's orbit responsible for the ice ages and other changes of climate over the millenia. A chapter on rockets and space ships concludes this section on the classical theory.

The advance made by Einstein, which even after half a century still seems to have many conceptual difficulties for the layman, is well explained in this book. The equivalence principle, that there is no essential difference between the gravitational field and any other accelerated system, here seems almost obvious; the bending of light rays in a gravitational field follows naturally and a brief mention of non-Euclidian geometry serves to introduce the notion of the curvature of space-time produced by material bodies. Gravity is still far from being explained, but we are one step further from 'the action at a distance' of Newton's day.

The concluding chapter deals with some unsolved problems of gravity, including the fundamental one of the relationship between gravity and the forces of electromagnetism and the fundamental particles. An interesting speculation, which seems to have disappeared from the discussions surrounding the neutrino experiments of the last few years, is that there may be some connexion between the neutrino and the graviton (the 'particle' of the quantized gravitational field).

Finally, lovers of science-fiction will be disappointed to learn that gravitational shielding would depend on the existence of 'antigravity', of particles with gravitational repulsion instead of attraction, which would be contrary to the equivalence principle. It is perhaps worth recalling here that Gamow's speculation on the possible (if improbable) possession of antigravity by antiparticles has since been disproved experimentally and the equivalence principle itself has been confirmed to an extremely high order of accuracy by the recent CERN experiment on K^0 decay.

A.G.H.

Plasma kinetic theory, by D. C. Montgomery and D. A. Tidman (New York, McGraw-Hill Book Co., 1964; \$11.50).

The authors of this book have set out to describe the present state of the theory of plasmas and especially of the kinetic theory. Their intention was to present and discuss the latter on the basis of the phenomena known when the book was published (1964), without, however, hazarding too many explanations. It can be said at once that the book clearly describes the principles of plasma kinetic theory, but it is not for the reader who wants to gain a grasp of the subject in a short time: the reader is expected to have considerable mathematical knowledge concerning the

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mechanics of fluids, electromagnetic theory and statistical mechanics.

In the first part, the authors recall the fundamentals of classical kinetic theory for a system of particles interacting through short-range forces. This is the case for molecular gases, to which the Boltzmann transport equation applies. However, this theory is incapable of describing the behaviour of charged particles interacting through long-range forces, such as Coulomb forces. More specifically, although it is possible to envisage a model of a molecular gas in which two particles interact for an infinitely short period of time, because molecular forces vary as $1/r^6$, such a model is no longer possible in a plasma, where the Coulomb forces vary as $1/r^2$.

In the second part of the book the authors describe the so-called BBGKY theory, which is the most systematic and the most powerful of the theories of statistical mechanics. It is applied to a single-component plasma, to provide a description, among other things, of its fluctuations and of the adiabatic hypothesis.

The third part of the book deals with more specific problems involving a larger variety of physical phenomena and plasmas more complex than the single-component one: plasmas in magnetic fields, 'hot' plasmas, electromagnetic radiation, etc. However, this third part, which is written from a different point of view, cannot be read on its own.

In conclusion, this book can be said to give a clear account of plasma kinetic theory, but it is not an introduction to plasmas and should not be the first book to be read on this subject.

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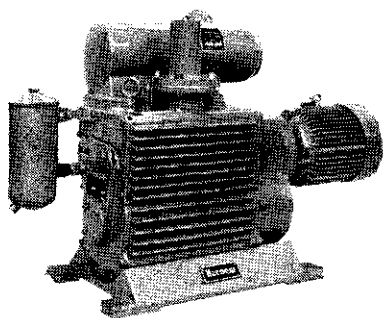
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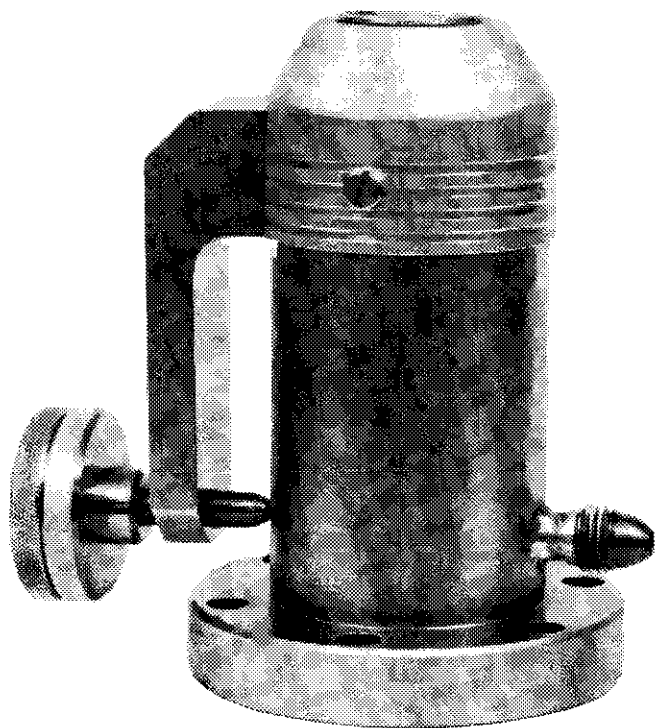
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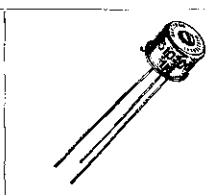
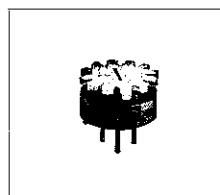
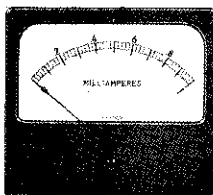
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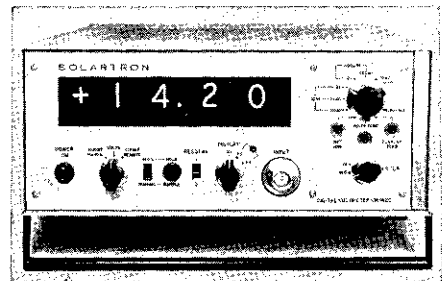
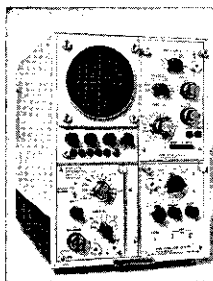
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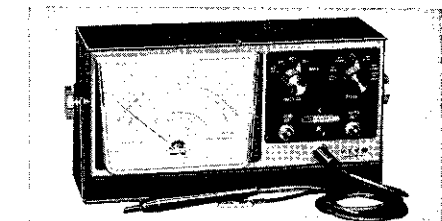
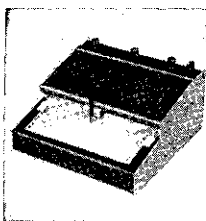
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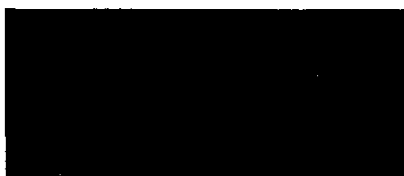
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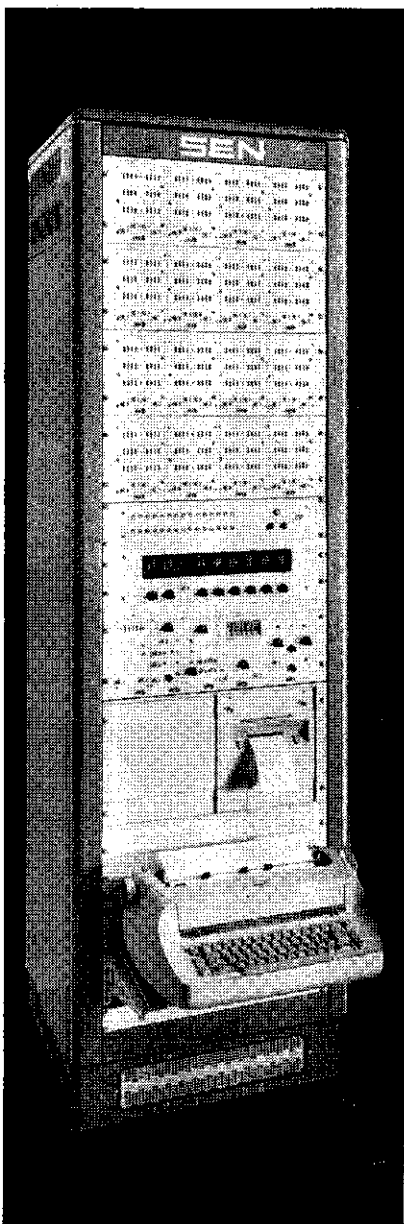
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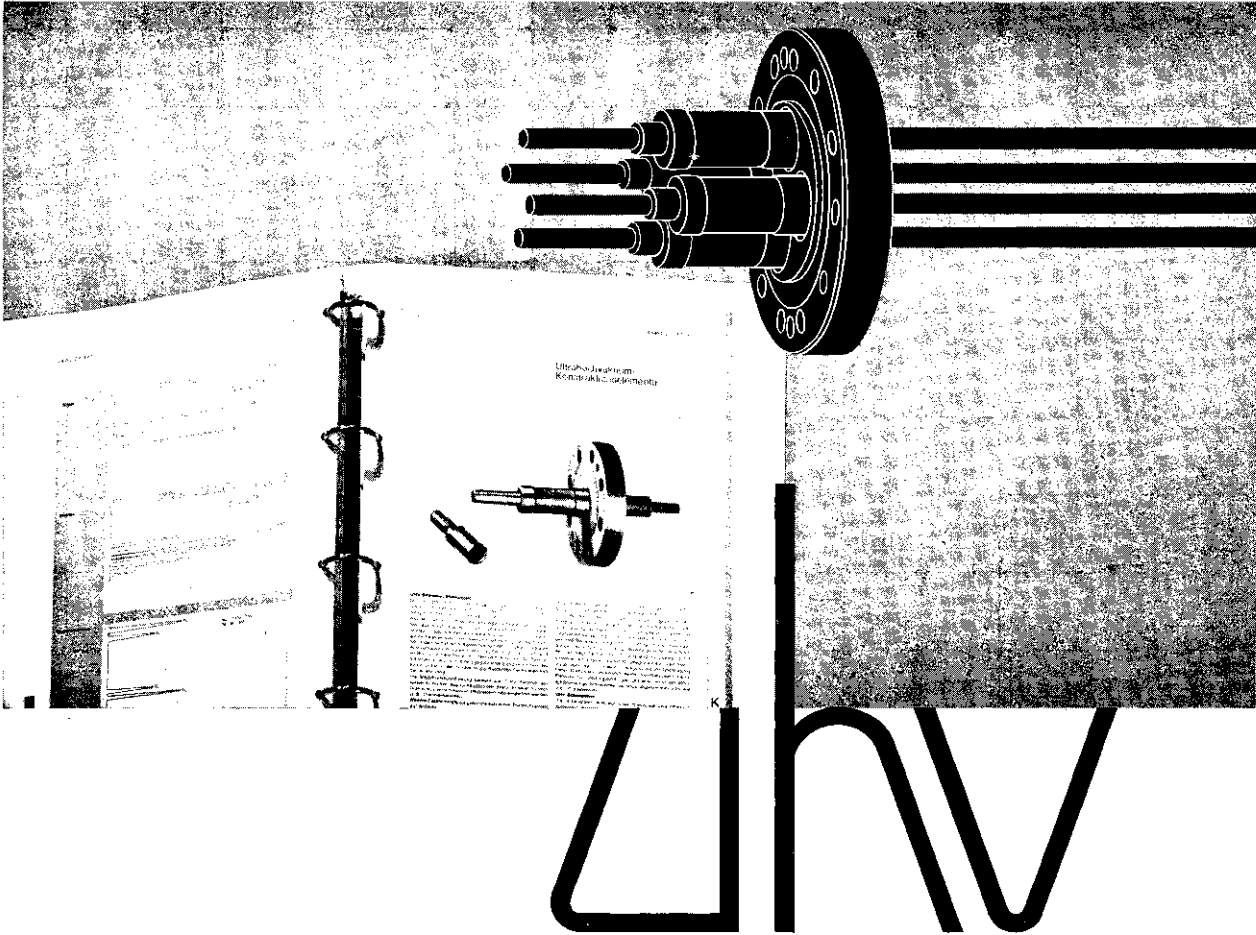
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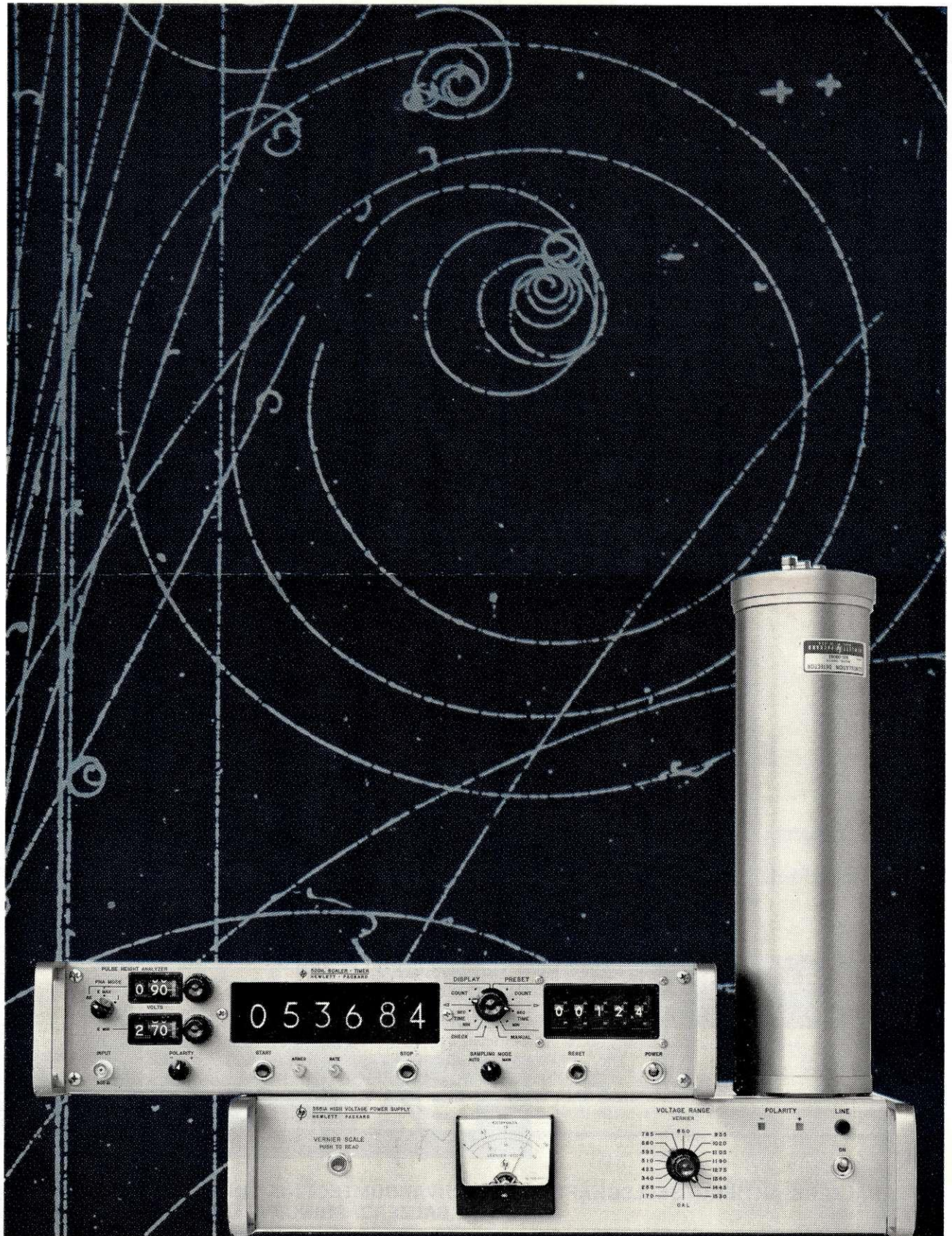
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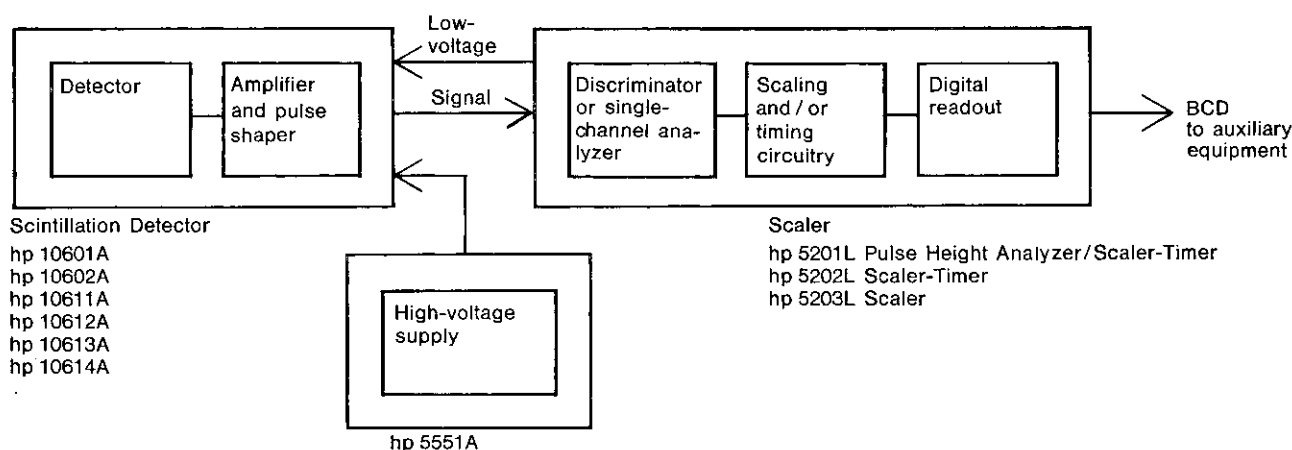
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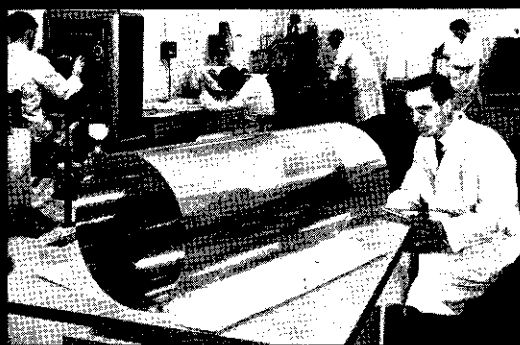
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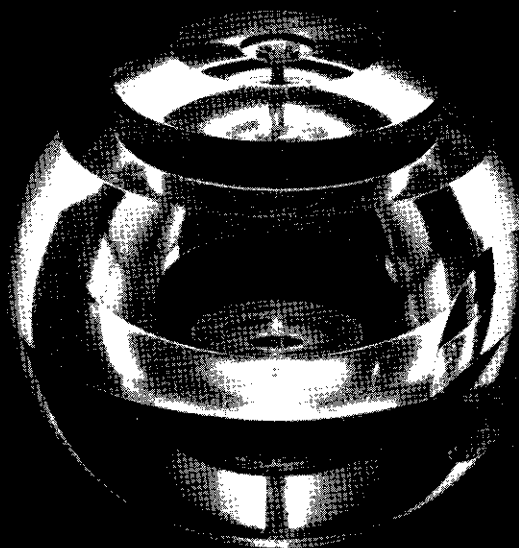
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