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LOGIC AND PROBABILITY IN PHYSICS[1]

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THE history of the development of physics in the first quarter of the twentieth century will rank as one of the greatest in the advancement of knowledge, but it will also rank as one of the most curious in the history of human thought. In 1901 Planck started the quantum theory. Even this was curious. He was trying to find out the law of complete radiation by the use of ordinary statistical methods, and observed that he got his answer at what should have been the last stage but one of his work. The last stage would have involved proceeding to a limit, and he found that he got the experimental answer without doing so, and an absurd answer if he did. The work went rather deep into statistical theory and there were many for long afterwards who were not convinced of its compelling force, but it was the great merit of Planck that he knew that he had got something involving a quite revolutionary idea—the quantum. In succeeding years other phenomena were seen to involve the same revolutionary idea: Einstein's theory of the photoelectric effect and of the ionization produced by x-rays, his theory of specific heats, later improved by Debye, and Bohr's theory of spectra. All these things fitted in quite obviously with the quantum, but quite as obviously they violently contradicted the physics of the nineteenth century. What should a man think about a beam of light which according to Einstein had to be composed of arrows, whereas a hundred years earlier Fresnel had *proved* that it was a sys-

[1] Concluding portion of the address of the president of the section of mathematical and physical science of the British Association for the Advancement of Science, meeting at Cambridge from August 17 to 24.

made rigid where it passes through the base by inserting a short segment of glass tubing. It fits the opening in the base snugly, but can easily be drawn up for tying the balloon. The light brass disc, of slightly smaller diameter than the balloon, is firmly attached to the lever *e,* whose fulcrum, at *f,* is adjustable on a rod soldered to the base. The lever is lightly counterpoised beyond the fulcrum. When the balloon has been fitted to its receptacle, it is cemented both to the receptacle and to the brass disc with rubber cement.

In order to smooth out irregularities in the shape of the balloon it has been found desirable to have the lever enough out of balance to raise pressure in the balloon about 5 mm H_2O. If this precaution is taken, there is an almost linear relation between volume change and angular movement of the lever. The range of the recorder is, of course, determined by the volume of the balloon used. Balloons with a volume of about 20 cc have been found satisfactory for most work.

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AN AQUEOUS MEDIUM FOR MOUNTING SMALL OBJECTS[1]

IN the course of investigating a group of small marine copepods the writer has searched for a rapid method of preparing mounts of the parts. Dissecting in glycerin has proved to be very satisfactory, but it was desirable to find a more satisfactory mounting medium than glycerin jelly for the very small parts. Articles recently published in SCIENCE[2,3] called attention to the possible usefulness of corn syrup (dextrose) and mixtures containing it. In following these suggestions, white Karo syrup alone was tried, but it was found to be very difficult to arrange the parts in position in the syrup, even when a very small drop was used; shifting invariably occurred after the cover-glass was added. With this medium it is also difficult to make the mount thin enough for the use of an oil immersion objective.

Dr. Zirkle's note on mounting media for the Belling acetone-carmine technique suggested a modification which has proved to be very satisfactory. The medium used is essentially Zirkle's mixture without the aceto-carmine:

White Karo syrup	5 cc
Certo (fruit pectin)	5 cc
Water	3 cc

A gram of powdered fruit pectin, dissolved in about 10 cc of water by boiling, may be used instead of Certo. A crystal of thymol is added as a preservative.

In making mounts with this mixture a very small drop is taken up with a fine needle and spread out upon a clean slide. The desired parts are immediately transferred to it and arranged as desired; if the drop is spread out rather thin the smallest parts (*e.g.,* copepod mouth parts) may be quite easily arranged. The mixture begins to "set" in about two minutes, and holds the parts firmly in position. If it should set before all the parts are in position, the excess may be scraped away and a fresh drop added. (The rapidity of setting can be controlled by varying the amount of water used in the mixture). When all parts have been arranged, the mount is dried to hardness over heat. If the cover-glass is put in place with another drop of the mixture a slight shifting of the mounted parts takes place, but this difficulty was overcome by adding the cover-glass with a drop of euparal, which does not dissolve the syrup-pectin mixture. The cover-glass can now be pressed down quite firmly without in the least disturbing the parts. An additional advantage of using euparal is that it can be dissolved off with 95 per cent. alcohol, if necessary, and the cover-glass removed without disturbing the parts. The syrup-pectin mount may then be softened by the addition of a fresh drop of the mixture and the objects rearranged, and the cover-glass added as before. It is not necessary to ring the cover-glass. The refractive properties of the syrup-pectin-euparal combination appear to be satisfactory, although the edges of the drop of syrup-pectin mixture appear as very faint lines.

Various small organisms have been mounted in this medium, both with and without euparal, with results quite as good as for the copepod appendages. If the cover-glass is mounted with the syrup-pectin, sufficient mixture must be used to prevent the formation of air pockets under the cover as the medium dries. Mounts made by the above methods have proved to be very satisfactory for study, and are apparently standing up very well, although none are more than ten months old. The rapidity and effectiveness of the method suggest that it may prove valuable to other workers.

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[1] Contributions from the Scripps Institution of Oceanography, New Series, No. 26.

[2] Ruth Patrick, SCIENCE, 83: 85.

[3] Conway Zirkle, SCIENCE, 85: 528.

BOOKS RECEIVED

GORTNER, ROSS A. *Outlines of Biochemistry.* Second edition, revised. Pp. xx + 1017. 165 figures. Wiley. $6.00.

READ, WILLIAM T. *Industrial Chemistry.* Second edition. Pp. ix + 605. 115 figures. Wiley. $5.00.

WATERFIELD, R. L. *A Hundred Years of Astronomy.* Pp. 526. Macmillan. $5.75.

WILLIAMS, ROBERT R. and TOM D. SPIES. *Vitamin B_1 and Its Use in Medicine.* Pp. xvi + 411. 19 figures. Macmillan. $5.00.