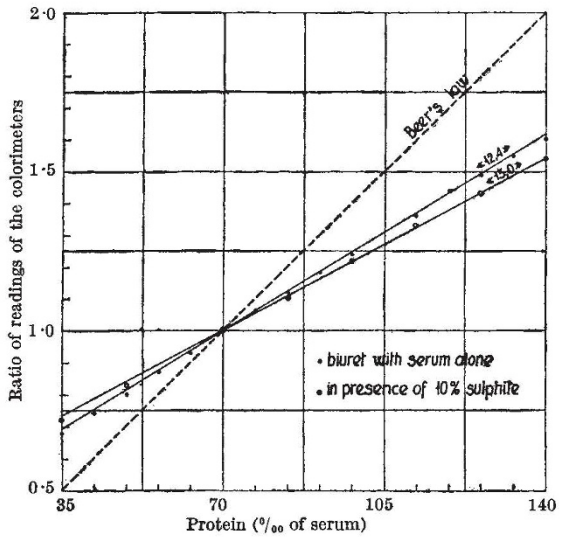
An Improved Biuret Reaction of Proteins and the Two-Standard Colorimetry

MEHL announced in 1945 [1] that by the use of ethylene glycol an alkaline copper reagent could be prepared in which copper, besides not being precipitated, could give the biuret reaction. At the high proportion in which glycol enters into Mehl's reagent, the presence of reducing impurities made it necessary to prepare the reagent in two stages, heating in order to speed up the reaction, and filtering in order to remove the precipitated copper. Nevertheless, the presence of the colour of the alkaline copper reagent causes the reaction to depart considerably from Beer's law; Mehl deduces from a spectrophotometric analysis that, starting from the 750 mμ and 545 mμ absorptions, the quantity of proteins present can be approximately calculated.

We have found that glycerine gives a better reagent for the biuret reaction than glycol, for the following reasons: the glycerine required is only a hundredth of the amount of glycol and there are no reducing impurities, thus making it possible to prepare the reagent in one stage.

This reagent is prepared by mixing 2 ml. of glycerin, 80 ml. of 5 per cent copper sulphate ($CuSO_4.5H_2O$) and 400 ml. of 20 per cent sodium hydroxide, and adding water up to 1 litre. This reagent is mixed, volume for volume, with the liquid under investigation (water being added if it is necessary in order to bring the final concentration of proteins to the value of about 1–2‰).

As regards the colorimetric valuation, we have found that it is possible by visually compared colorimetry using our two-standard colorimetry system [2]; although theoretically it should not be possible, as it is an 'impurity' which varies according to the intensity of the reaction. It is interesting to note that the interference of sodium sulphite at half the concentration corresponding to the precipitation of globulins can also be removed by two-standard colorimetry.



The accompanying graph records two sets of experimental data giving serum proteins as parts per thousand of serum (the final concentration of the same being about 2 per cent). The slight deviations from the straight lines which represent particular cases in our general equation of compared colorimetry [3] do not prevent the practical determination of serum proteins. The increased deflexion caused by the sulphite comes fully into the field of utility of two-standard colorimetry.

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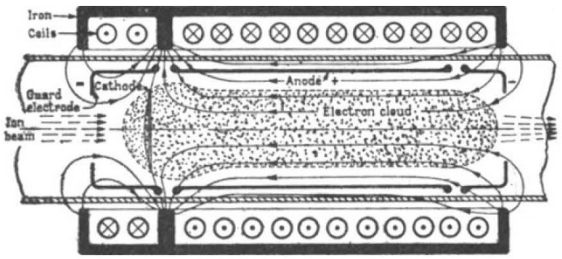
[1] Mehl, J. W., *J. Biol. Chem.*, **157**, 173 (1945).
[2] Sols, A., *R. esp. Fisiol.*, **1**, 355 (1945).
[3] Sols, A., *An. Fis. Quim.*, **42**, 855 (1946).

A Space-Charge Lens for the Focusing of Ion Beams

SOME time ago I proposed a magnetron of special design as a divergent lens for electron beams [1]. It now appears that the same device may become useful as a very powerful concentrating lens for positive ions, particularly for ion beams of extreme energy.



MAGNETRON LENS FOR ION BEAMS

In the design shown in the illustration, a magnetic field is produced by two coils of uneven length, in opposition. A hot cathode in the form of a circular loop is arranged at or near the magnetic field-line which crosses the axis. This arrangement is necessary, as electrons which have to cross magnetic flux lines are prevented by their angular momentum from reaching the axis. In the region where the magnetic field is approximately axial and homogeneous, a cylindrical electrode, the 'anode', is arranged, with high positive potential with respect to the cathode. So long as the anode potential is below a certain critical value, the magnetic field prevents all but a small fraction of the electrons from reaching the anode. At the two ends, guard electrodes with potentials somewhat below the cathode potential prevent the electrons from escaping. Thus the space accessible to electrons is limited from all sides, and will have an outline approximately as shown in the figure. Into this space the cathode will pour electrons, until the potential in the axis is depressed to very nearly cathode potential, and equilibrium is established.

According to the theories of Hull [2] and Brillouin [3], in the steady state the electrons rotate around the axis in equilibrium orbits, such that the electrostatic repulsion of the electrons inside the orbit together with the centrifugal force balance the radial Lorentz force produced by the magnetic field. The electron distribution in the cloud is uniform, with a space-charge density

$$\rho_H = -\frac{eH^2}{8\pi m_e c^2}, \qquad (1)$$