Our discussion has for topic the permeability of the protoplasm. Prior to such a discussion we must, however, decide on the sense in which we want to use the term permeability. In the past it was applied in a very wide sense. Today we prefer the restricted and more closely defined sense of the term.

In Europe we must stress the importance of a clear distinction between permeation—a spontaneous process that occurs in accordance with Fick’s diffusion law—and accumulation, an involuntary process that takes place actively, i.e. concurrently with an energy output on the part of the cell. This contrast is generally known in this continent. It is beyond any doubt that the salt uptake by the root from dilute soil solution mostly requires active performance on the part of the cell, at least in the slowly transpiring plants. This is why, in nutritional physiology, there is more interest at present in accumulation than there is in permeation.

At our Congress, we have had discussions on Water Uptake, Apparent Free Space, Uptake and Transfer of Ions. I very much hope that this discussion will show that permeability, too, has by no means lost its topicality.

Together with Collander, Danielli, et al. we use the term permeability for the diffusion across a membrane taking place in accordance with Fick’s law. Permeation through the plasm is an inhibited diffusion. After all, the living cell must shut itself off from its environment, it must inhibit or control the diffusion of its contents, whereas diffusion in an inward and diffusion in an outward direction are equal. The permeation resistance of the protoplasm to various substances is able to characterize the living plasm from a physico-chemical point of view, and to distinguish it from all other systems. Thus, a knowledge of the living plasm is the main objective of permeability research, and it is along these lines that it is being pursued by us, the protoplasmodists. It should, however, be mentioned that it is largely the concern about the constitution

1 Paper, read before the IXth International Botanical Congress at Montreal on August 25th, 1959 — introducing the Organized Discussion “Permeability of Protoplasm.”
of the plasm, in particular in that of the ground plasm (hyaloplasm in an electron microscopic sense) that has given rise to fresh interest in plasma-permeability.

Plasma permeability to non-electrolytes is best-known today. In this field it is mainly C o l l a n d e r and his school in Helsingfors and, in the second place, our Vienna group that, for decades, have continually made essential contributions. We need not today discuss permeability to ions as it is well established that lipid-soluble molecules permeate readily, whereas ions which, by their nature, are tied to the aqueous medium, permeate with difficulty or do not permeate at all. The best example therefore is furnished by vital staining with basic dyes. It is well known, that in vital-dye solutions the undissociated, lipid-soluble part will permeate, whereas the dissociated part will not permeate and will stain only the cell walls and the gelatinous masses outside the semi-permeable plasma barrier, either electro-adsorptively or by chemical combining. During these ten years, much work in this field has been done in Vienna, in West-Berlin and Münster, summarized by D r a w e r t (1956) in R u h l a n d's Encyclopedia (cf. S t r u g g e r 1949, Höfler 1953b, Biebl 1958).

From a viewpoint of permeability, we are interested in the main result which is beyond any doubt: the lipid-soluble part of the dyes permeates, and the lipid-insoluble part does not; dyeing experiments with dye-baths of varied pH values, which were first used by S t r u g g e r, would be a sufficient proof for O v e r t o n's classical lipid theory, if such a proof were still required. We know that basic dyes are dissociated over the acid range, and molecular over the alkine one, the transition ranges of the single dyes being at different positions in the pH series.

It is a well known fact, confirmed especially by D r a w e r t and his school, that the basic vital dyes permeate: passively in accordance with Fick's law, and are then accumulated by the cell in a variety of ways and by different mechanisms (cf. F. K i n z e l 1954, 1959); whereas the majority of the acid dyes are introduced into the cell by metabolic activity, uptake being prevented by lack of oxygen and by narcosis. Methyl red constitutes a significant exception: It is an acid dye, but, [due perhaps to the presence of a basic N(CH₃)₂ group], permeates rapidly and passively, and, due to its acid character, facilitates the elective staining of parts in the protoplast, e. g. of the oil bodies of Hepaticae, which are not stained by basic dyes. Father Z ő t t l's (1960) detailed paper thereon is to be published in Protoplasma in the near future.

As is well known, there are two quantitative methods for the study of non-electrolyte permeation, namely C o l l a n d e r's method of the micro-chemical analyses of the cell saps of large coenocytic cells, and the plasmomometric method. Dr. S t a d e l m a n n will give you the details of the latter method. A proper application of this method will clearly yield values for permeability, and not mixed values from permeation and active accumulation or non-osmotic uptake. We have tried to prove this fact in view of the objections raised by B o g e n, P r e l l, and F o l l m a n n, and advanced (1956) in R u h l a n d's Encyclopedia. C o l l a n d e r, in 1933, used Chara ceratophylla (Fig. 2) in the determination of the permeation constants of 45 non-electrolytes: and, in 1954, Nitella mucronata for that of the permeation of 70 non-electrolytes, an improved method being employed this time: The substance to be tested was first permitted to saturate the cell, then the