In these solutions, the episporium also discolours while it dissolves in higher concentrations.

The contents of the ascospores are optically rather homogenous. Besides a single nucleus with a large nucleolus the plasm of the ripe spore contains only a few granules and vacuoles. Glycogen can be demonstrated in the sporoplasm.

ARRANGEMENT OF ASCOSPORES.—In *Ascobolus* the spores are mutually free. At first they are usually arranged in a single row. But when the ascus stretches there often becomes space available for a double row of longitudinally disposed spores or a single row of obliquely disposed ones. Sometimes the very thick, mucilaginous substance adhering to the spores prevents the formation of a double row.

Very large asci, such as occur in *Ascobolus* sect. *Dasyobolus* and sect. *Sphaeridiobolus*, often show an irregular disposition of the spores in more than two rows.

In the ripe ascus, in optimal condition for the discharge of its contents, the spores have been shifted towards the axis of the ascus just behind the operculum. In this phase the spores are contained in a very large vacuole that may almost completely fill the ascus. The spores are never regularly arranged, according to a fixed pattern, in *Ascobolus*.

In *Saccobolus* the spores are only very rarely free. Mostly they are regularly united into a cluster and cemented together by the episporial pigment. In cases where this pigment was already precipitated before the spores were pressed together, they remain free; this is the case in *S. saccoboloides*. Sometimes the episporial pigment forms only a weak connection; it may be partly soluble in water. As result, the spores of *S. globuliferellus*, *S. geminatus*, and *S. infestans* may easily come apart.

The 'common hyaline sack' which is found in some species of *Saccobolus* sect. *Saccobolus* scarcely plays a role in keeping the spores together, as was supposed by Boudier (1869).

The following patterns of arrangement of the spores are distinguishable in species of *Saccobolus*.

Pattern I (Fig. 2a–b): with four rows of two longitudinally disposed spores, and two longitudinal planes of symmetry. This is typical of *Saccobolus* sect. *Saccobolus*.

Pattern Ia (Fig. 2c): a longitudinally contracted form of pattern I (e.g. *S. truncatus*).

Pattern II (Fig. 2f–g): with two rows of three and one row of two spores, and a single longitudinal plane of symmetry. The axes of the spores are about parallel to the axis of the package (e.g. *S. caesariatus*, *S. beckii*, and *S. verrucisporus*).

Pattern III (Fig. 2h): with two terminal pairs of spores parallel to the axis of the package and two median pairs of obliquely disposed spores (together with pattern II in *S. versicolor* and *S. depauperatus*).

Pattern IIIa (Fig. 2i): a longitudinally contracted form of pattern II or III; often rather irregular (*S. portoricensis* and *S. globuliferellus*).

Pattern IV (Fig. 2j): a subglobular package (*S. dilutellus*).

Pattern V: with only four spores in a package,

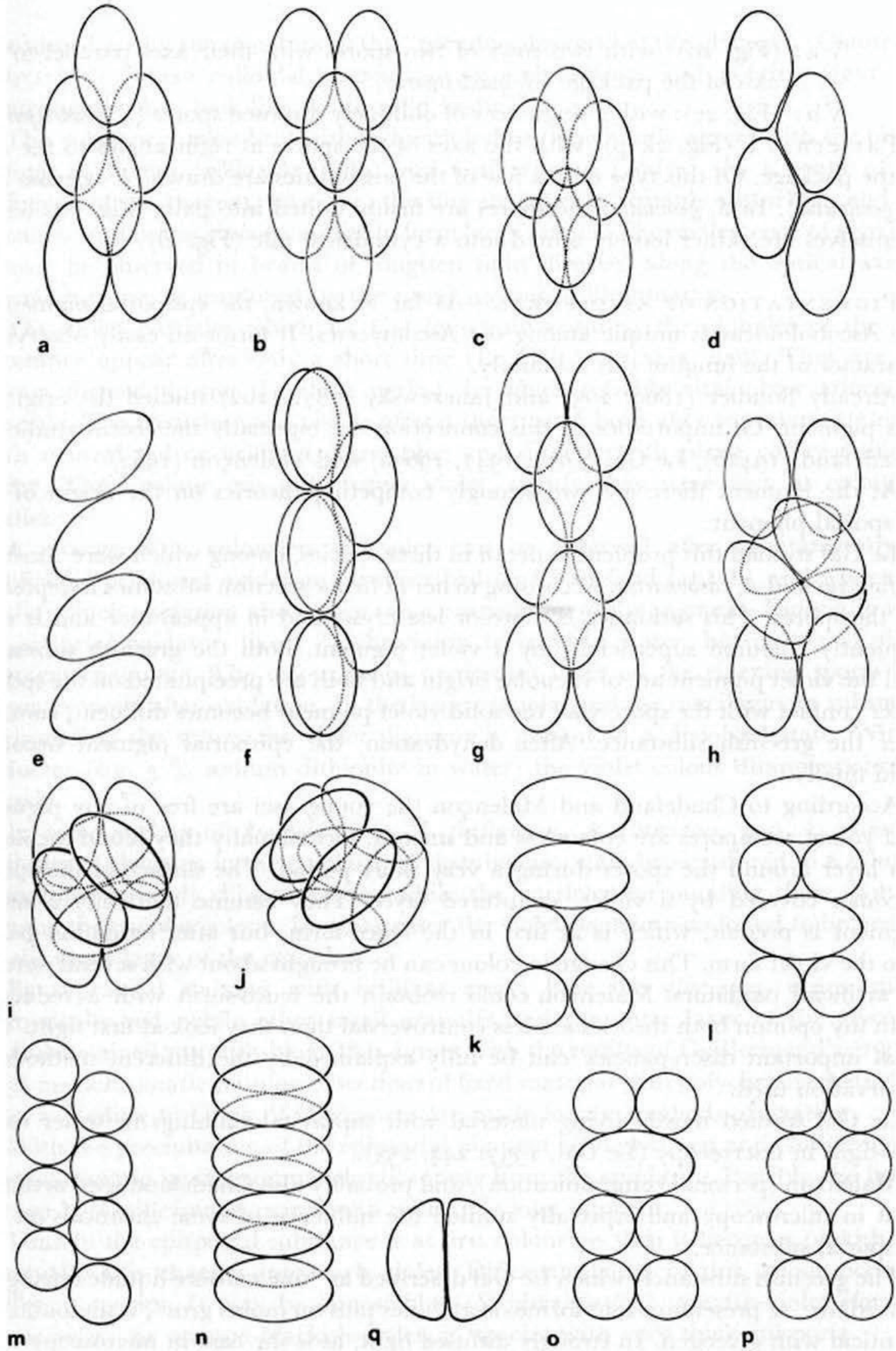

Fig. 2. — Arrangement of ascospores in *Saccobolus*. For explanation see text.

Va: (Fig. 2d): with two rows of two spores with their axes parallel to the axis of the package (*S. quadrisporus*).

Vb: (Fig. 2e): with a single row of obliquely disposed spores (*S. quadrisporus*).

Pattern VI (Fig. 2k–p): with the axes of the spores at right angles to the axis of the package. Of this type only a few of the possibilities are drawn (*S. infestans* and *S. geminatus*). In *S. geminatus* the spores are firmly united into pairs (Fig. 2q) which themselves are rather loosely united into a cylindrical pile (Fig. 2l).

PIGMENTATION OF ASCOSPORES.—As far as known, the episporial pigment of the Ascoboloideae is unique among the Ascomycetes. It forms an easily observable character of the fungi of this subfamily.

Already Boudier (1869: 203) and Janczewsky (1872: 202) studied the origin of this pigment. Of importance in this connection are especially the recent studies of Chadefaud (1942b), Le Gal (1942, 1947, 1963a) and Malençon (1962).

At the moment there are two strongly competing theories on the origin of the episporial pigment.

Le Gal studied this problem in detail in three species, among which were *Ascobolus furfuraceus* and *A. carbonarius*. According to her at first a greenish substance is deposited on the spores. This substance is more or less crystalloid in appearance and is subsequently coloured superficially by a violet pigment. Both the greenish substance and the violet pigment are of vacuolar origin and both are precipitated on the spores. After contact with the spore-wall the solid violet pigment becomes diffluent, running over the greenish substance. After dehydration, the episporial pigment becomes solid finally.

According to Chadefaud and Malençon the young asci are free of any pigment and young ascospores are colourless and smooth. Occasionally they found a colourless layer around the spores during a very short period. The surface of the spores becomes covered by a violet, sculptured layer. They assume that only a single pigment is present, which is at first in the leuco-form, but after oxidation passes into the violet form. This change in colour can be brought about with several natural or artificial oxidators. Malençon could reobtain the leuco-form with a reductor.

In my opinion both theories are less controversial than they look at first sight. The most important discrepancies can be fully explained by the different methods of observation used.

Le Gal studied mostly living material with supravital stainings in water using day-light in microscopy (Le Gal, 1957: 244, 253).

Malençon (personal communication), and probably also Chadefaud used artificial light in microscopy and especially studied the influence of some chemicals on the episporial substance.

The greenish substance, which Le Gal described as "une matière liquide réfringente verdâtre, se présentant sous forme de globules plus ou moins gros", is undoubtedly identical with glycogen. In strongly diffused light, as is the case in microscopy with day-light, the green opalescence is very conspicuous. The crystalloid appearance is