Zytomorphologische Untersuchungen durch Lebendfärbung an Primula malacoides-Zellen.

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An Hand anderer Untersuchungen ist es nötig gewesen die physiologische und morphologische Reaktion der *Primula malacoides* Zellen auch durch Lebendfärbung zu untersuchen. Zu diesem Zwecke habe ich Methylenblau und besonders Neutralrot verwendet. Da ich die zytologischen Eigenschaften der Zellen in verschiedenen Pufferlösungen gehaltener Pflanzenteile und Keimlinge mit den der normalen Zellen vergleichen wollte, musste ich erst die Zellen normaler Pflanzen in dieser Hinsicht kennen lernen. Später konnte ich es allerdings feststellen, dass das pH der Umgebung die Farbstoffaufnahme und Speicherung nicht oder nur unbedeutend beeinflusst, da dabei wahrscheinlich das pH des Zytoplasmas und des Zellsafts unverändert bleibt. Die grossen Veränderungen in den plasmolytischen Verhältnissen scheinen auf die Farbstoffaufnahme nur in dem Falle einen Einfluss auszuüben, als auch Organellen der Zelle tiefgreifende Veränderungen aufweisen.

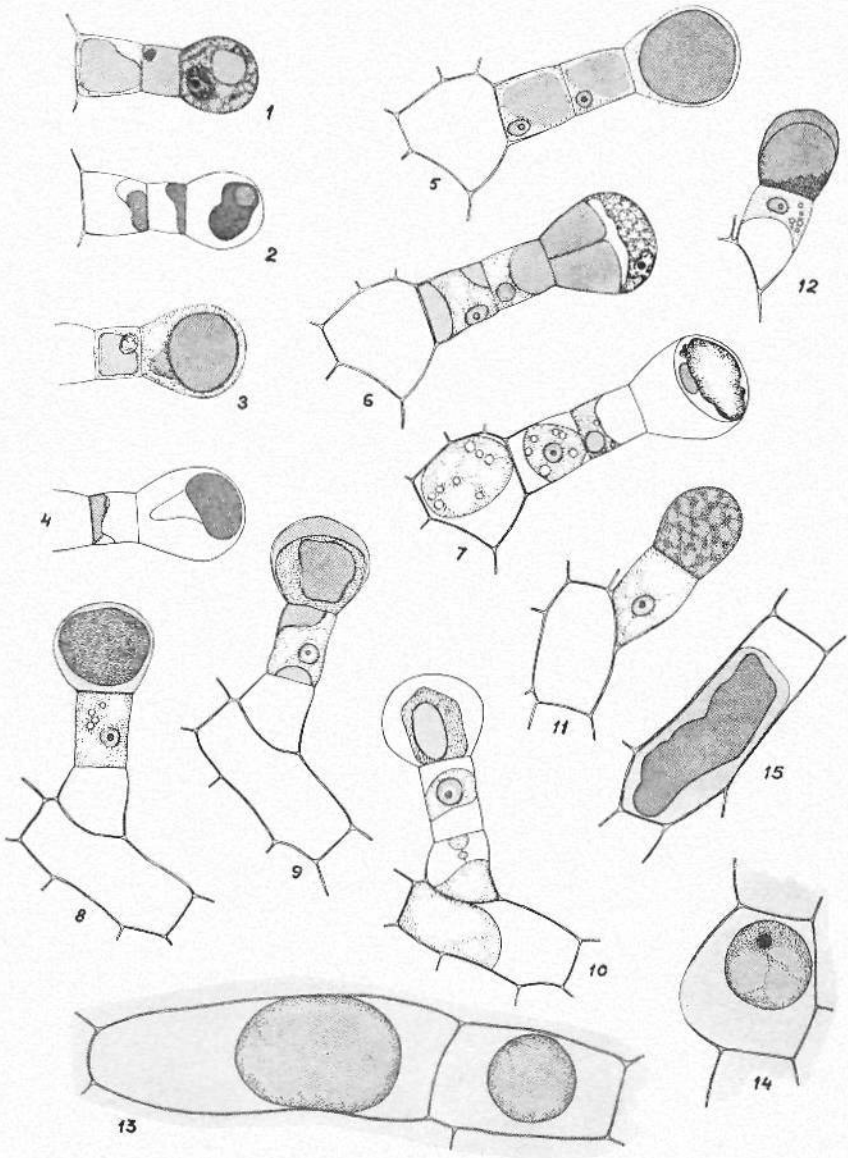
Um die traumatischen Einwirkungen auszuschalten, habe ich immer entweder grössere Gewebekomplexen oder Keimpflänzchen in toto untersucht. In beiden Fällen schienen die epidermalen Zellen (Epidermis- und Haarzellen) ein besonders günstiges Objekt zu sein.

Die Haare haben schon bei den ersten Untersuchungen deutlich gezeigt, dass die Spitzenzellen viel schneller als andere Zellen des Haars die genannten Farbstoffe aufnehmen. Diese sind normalerweise mit einem gelblichen, stark lichtbrechenden Stoff gefüllt, der hierbei eine gewisse Rolle spielen kann. Wahrscheinlich ist es aber, dass auch neben kutikulären Verschiedenheiten plasmatische Eigenschaften dieser drüsenartigen Spitzenzellen einen leichteren Eintritt der Farbstoffmolekülen (Ionen?) ermöglichen. In diesem Zusammenhang möchte ich an den Parallelismus hindeuten, der mit der Asparagin-Aufnahme

der *Drosera*-Tentakeln vorhanden ist (vgl. ARISZ 1941 u. 1943, wo eine Aktivität in der Aufnahme und Speicherung nachgewiesen werden konnte).

Das ungleichmässige Speicherungsvermögen der Haarzellen zeigen z.B. die 1, 3, 5, 8, aber auch alle andere einschlägige Figuren nicht plasmolysierter Haare deutlich. Bei der Farbstoffaufnahme, die bei den gebrauchten Konzentrazionen (1 : 1000 und 1 : 10 000 in dest. Wasser) schnell verlief, erscheinen kürzlich die Konturen der Vakuolen, die in ungefärbtem Zustand nicht zu unterscheiden waren. Den Vorgang in einer Farbstofflösung 1 : 10 000 unter dem Mikroskop verfolgend, muss man feststellen, dass durch die Farbstoffaufnahme Veränderungen sowohl in der Morphologie des Vakuoms, als auch in dem Bau des Tonoplasts eintreten. Durch die Auffassung FREY-WYSSLING's (1948) wäre es anzunehmen, dass hier das Tonoplast von einer z.B. bimolekulären in eine polymolekuläre Form übergeht. Diesen Übergang verursachen sicherlich die eindringenden Farbstoffmolekülen (Ionen) und gehen wahrscheinlich auch mit anderen Veränderungen in dem Zytoplasma gepaart, die die Irreversibilität der Veränderungen zustande bringen.

Die Irreversibilität kann man besonders gut durch Plasmolyse der gefärbten Zellen beweisen, welcher Vorgang auch mit einer anderen merkwürdigen Erscheinung geknüpft ist. Bei der Plasmolyse durch einen Elektrolyt (KNO_3 $^1/_2$ mol.) kontrahieren sich nicht nur die gefärbten Vakuolen, aber auch das Zytoplasma, wodurch eigentümliche Bilder entstehen. Bei Neutralrot bleiben die Vakuolen gefärbt, die Tonoplasten stark lichtbrechend, die Formen dieser zusammengezogenen Gebilden lassen aber auf eine höhere Viskosität des gefärbten Zellsafts schliessen. Die Einzelheiten, die auf den Fig. 2 und 4 dargestellt sind, könnte man auf einer anderen Weise nicht erklären. In sehr ernsten Fällen der Vergiftung bleibt das ganze Protoplast gefärbt, in ihm erscheinen kleinere Vakuolen, grobe Strukturen, Entmischungserscheinungen usw. (Fig. 2, Spitzenzelle). Dass hier wirklich eine schwere Farbstoffvergiftung vorliegt, wird auch dadurch bewiesen, dass das Neutralrot schon auch durch den Zellkern aufgenommen wurde. Hier konnte ich es auch — als in so vielen anderen Fällen (vgl. z.B. CHOLNOKY 1934 und 1935) — beobachten, dass sich die Kerne lebender Zellen nur in einem praemortalen Zustand färben. Mit dieser Tatsache ist die Auffassung von MALVESIN-FABRE (1941) kaum in Übereinstimmung zu bringen. Die Struktur und Dimensionen der so vergifteten Zellkerne kann natürlich nichts zur Kenntnis normaler Zellkerne beitragen.



1, 3 Haare einer Keimpflanze mit Neutralrot gefärbt. — 2, 4 Plasmolyse derselben Haare durch $^1/_2$ mol KNO_3. — 5, 8, 11 Haare der Keimlingen durch Methylenblau gefärbt. — 6, 7, 9, 10—12 Plasmolyse derselben Haare durch $^1/_2$ mol KNO_3. — 13 Plasmolyse durch Rohrzucker in den Wurzelepidermiszellen nach Methylenblaufärbung. — 14 Dieselbe eines unvollkommenen Wurzelhaars. — 15 Plasmolyse und Vakuolenkontraktion in einer Epidermiszelle des Stengelchens nach Lebendfärbung mit Methylenblau.

Mit Methylenblau verläuft die Aufnahme und Speicherung beinahe gänzlich auf der beschriebenen Weise (Fig. 5, 8 und 11, die Spitzenzelle des letzteren kleinen Haars enthielt so viel gelber Stoff, dass die Konturen der Vakuole nicht erkenntlich waren. Bei der Plasmolyse durch einen Elektrolyt ($^1/_2$ mol KNO_3) begann der Farbstoff unmittelbar aus dem Protoplast herauszutreten. Einige Zeit lang blieb die wässerige Farbstofflösung (?) zwischen den Zellwänden sichtbar (Fig. 6, 9, 12), schliesslich diffundiert aber diese in das Plasmolytikum und bleiben nur die gekontrahierten Protoplasten übrig. Eine Endplasmolyse mit konvexen Oberflächen erreicht man aber nur bei den schwach vergifteten Zellen (Epidermiszelle unter dem Haar der Fig. 5—6—7), die anderen zeigen eine ausdrückliche Unregelmässigkeit in der Verteilung der Viskosität und ausserdem bleiben auch die (»polymolekulären») Tonoplasten sichtbar, die mit ihren scharfen Konturen auch in stark gekontrahierter Form (Fig. 7, unterste zwei Zellen) leicht erkenntlich sind. In diesen Fällen muss man eine Quellung des Zytoplasmas annehmen, die in den Spitzenzellen niemals so ausdrücklich ist (vgl. die Serie Fig. 8—9—10). Bei dem Haar der Serie Fig. 5—6—7 ist im Vakuom kaum etwas Farbstoff zurückgeblieben, in anderen Fällen aber, z.B. in der Spitzenzelle der Serie Fig. 8—9—10, blieb immer ein wenig zurück. In den mit dem gelben Stoff übervollen Zellen (Fig. 11—12) sind diese Einzelheiten nicht so deutlich sichtbar. Auch hier bleibt aber meistens Farbstoff in der Zelle zurück, wodurch die ursprüngliche gelbe in eine grüne Farbe übergeht. Die sichtbar werdenden Kerne zeigen es auch hier, dass von normalen Zustanden auch nach einer Methylenblauvergiftung keine Sprache sein kann.

Diese Verschiedenheit in der Speicherung von Methylenblau und Neutralrot scheint mir meine früheren Annahmen über die Verbindung der intrameierten Farbstoff-Ionen mit den Molekülen des Protoplasts und dadurch eine Inaktivierung derselben (vgl. CHOLNOKY l.c.) noch verstärken. So ist es eben erklärlich, dass die eine Farbstoff wohl permeieren, bei der Plasmolyse das Protoplast aber nicht mehr, dagegen der andere es leicht, zumindest teilweise, verlassen kann. Hier muss man die Ursache dieser Erscheinungen in den Molekülen suchen, die die Farbstoffen gebunden haben, und die in diesen zwei Fällen in ihrem Bau sicherlich voneinander abweichen. Die durch die Farbstoffe mitgerissene Molekülen können sowohl die hohe Viskosität der Zellsaft, als auch das teilweise Zurückbleiben der Methylenblauverbindungen erklären. Durch diese Annahme ist es auch verständlich, warum die durch die Farbstoffaufnahme verursachten Veränderungen irreversiebel

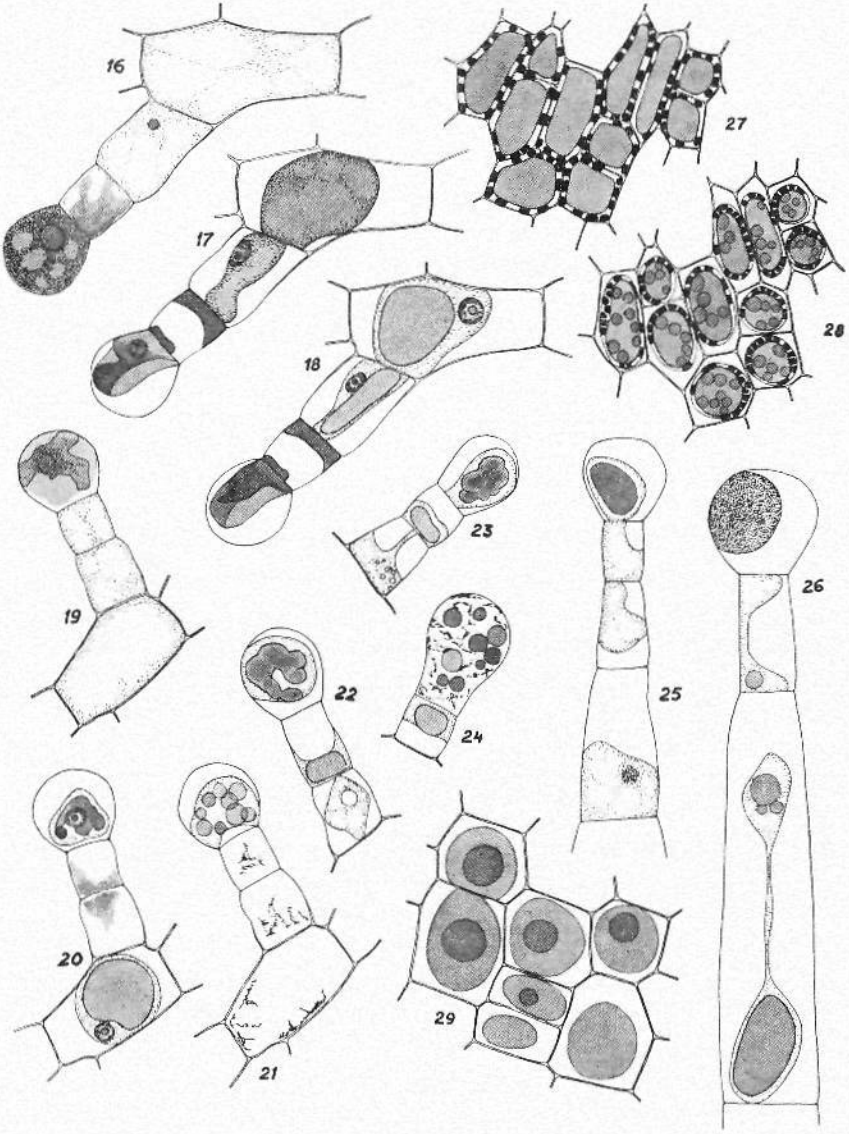
sind und schliesslich finden wir hierin auch die Erklärung dafür, warum die Zellkerne erst nur bei schweren Vergiftungen angefärbt werden. Ich halte es nämlich für sehr wahrscheinlich, dass die Kerne nur dann durch die Farbstoffionen angegriffen werden, als alle farbstoffbindende Molekülen des Zytoplasmas (und des Vakuoms) schon verbraucht sind. Dieselben Erfahrungen hatte auch BUCHY (1941) bei den Hefezellen, obschon ich seine Auffassung über die Giftigkeit der Farbstoffen nicht teilen kann, da eben durch die Irreversibilität der Veränderungen von einer »unschädlichen» Farbstoff — in der für gewöhnliche Lichtmikroskope gebräuchliche Konzentration — kaum die Sprache sein kann. Das bezieht sich auch, als oben schon bemerkt, auf die Vakuolen, wo ich das Sichtbarwerden des Tonoplastsals ein Zeichen irreversiebler Störungen nachweisen konnte (im Gegensatz zur Auffassung von GUILLERMOND und GAUTHERET, 1946). Die durch GUILLERMOND und GAUTHERET (l.c.) beschriebene Exkrezion geschieht nicht ohne Mitreissen lebenswichtiger Molekülen aus dem Protoplasma.

Das leichte Austreten des Methylenblaus (der Methylenblauverbindung) durch Plasmolyse ist nur bei den Haarzellen zu beobachten. Andere Zellen — z.B. die Epidermiszellen der Würzelchen der Keimlinge — zeigen andere Verhältnisse. Die Lösungen von Nicht-Elektrolyten (Rohrzucker $^1/_2$ und 1 mol) verursachen in diesen grossen Epidermiszellen konvexe Endplasmolysen. Das Methylenblau färbt auch die Wände an, so dass auch diese gefärbt bleiben. Einen Austritt des Farbstoffs konnte ich niemals beobachten (vgl. Fig. 13 und 14, letztere stellt ein unvollkommen entwickeltes Wurzelhaar dar), obschon die Farbstoffaufnahme dieser Zellen ebenso schnell vor sich geht, als die der Haarzellen (Spitzenzellen).

Die Plasmolysen verlaufen aber gänzlich anders, als man KNO_3-Lösung ($^1/_2$ mol) anwendt. Am Anfange der Plasmolyse erscheint unmittelbar eine Vakuolenkontraktion. Das Methylenblau verlässt das Vakuol aber auch hier nicht. Auch das Protoplast bleibt gefärbt, zeigend, dass hier Farbstoffionen in dem Protoplasma gebunden sind, die teilweise in dem Zytoplasma »hangen» geblieben sind und nur teilweise in das Vakuom ausgesondert wurden. Diese Erscheinung ist nur mit der Annahme möglich, dass hier verschiedene Molekülen (Mizellen) das Methylenblau gebunden haben, die sich eben durch diese Verschiedenheit auch in Hinsicht der Aussonderung verschieden verhalten. Die oben bei der Behandlung der Haarzellen beschriebene Verschiedenheit der die Zelle verlassenden und der in dem Vakuom verbleibenden Farbstoffverbindungen kann man auch in diesem Falle wahrnehmen.

Um die Vakuolenkontraktionen in den Haarzellen näher kennen zu lernen, ist es mir nötig erschienen, diese Zellen eingehender zu untersuchen. Die hier folgenden Experimente wurden mit Neutralrot als Farbstoff (1 : 10 000) und $^1/_2$ mol KNO_3-Lösung als Plasmolytikum ausgeführt.

Die Farbstoffaufnahme in der Serie Fig. 16—17—18 ist ebenso gewesen, als es schon beschrieben wurde. Das verschiedene Mass der Intrameation kann man aus der Intensität der Farbe der einzelnen Zellen gut beurteilen (Fig. 16). Es ist schon in nicht plasmolysiertem Zustand auffallend, dass der Farbeton in der Spitzenzelle wärmer, d.i. gelblicher ist. Das Farbstoff ist in diesem Zustande nicht nur in dem Vakuom, aber auch in dem Protoplast reichlich angehäuft und so konnte man in keiner der Zellen die bei minder reichlicher Farbstoffaufnahme nach einiger Zeit sichtbar werdenden Vakuolen wahrnehmen. Auffallend ist es aber, dass in Zellen, die scheinbar farblos sind, einzelne kleine Vakuolen oder Tröpfchen doch speichern können, zeigend, dass auch in diese Zellen eine Intrameation stattgefunden hat, die vorhandenen Farbstoffionen sind aber entweder in einer ungenügender Konzentration, oder noch in einer ungeschickten Form, um sichtbar zu sein. Die Plasmolyse dieser Zellen scheint die Wahrscheinlichkeit der zweiten Auffassung zu erhöhen, da in diesem Falle (ohne weitere Farbstoffaufnahme, die Farbstofflösung wurde ja vor dem Plasmolyseversuch ausgewaschen) die Protoplasten der vor der Plasmolyse farblosen Zellen rot erscheinen. Die Plasmolyse selbst geht immer mit Entmischungserscheinungen gepaart vor sich (vgl. Fig. 17) und die Farbe der Zellen, die mehr Farbstoff aufgenommen haben, schlägt gleichzeitig in eine lebhaft gelblichrote, beinahe orangerote Schatierung über. In vielen Zellen erscheinen auch die durch die Farbstoffvergiftung desorganisierenden, mehr oder minder pyknotischen Kerne. Die Spitzenzelle, und ab und zu auch die zweite zeigen auch später keine Spur einer Vakuolenkontraktion. Der Tonoplast selbst ist auch nicht sichtbar. In den Zellen aber, wo die Farbstoffaufnahme relativ gering war und die vor der Plasmolyse farblos waren, erscheinen nach 15—20 Minuten der Plasmolyse die Konturen eines sich allmählich zusammenziehenden Vakuols und einige Minuten später entsteht eine Vakuolenkontraktion mit dem »polymolekulären» Tonoplast (Fig. 18). Die Entmischungserscheinungen in dem Plasma verursachen grobe Körnung, die bis zu der Desorganisation sichtbar bleibt. Eine Deplasmolyse konnte ich niemals erreichen, obschon ich es immer wieder auf der vorsichtigsten Weise versucht habe.



16 Haar eines Keimlings mit Neutralrot gefärbt und 17, 18 durch $^1/_2$ mol KNO_3 geplasmolysiert. — 19—21 dieselbe Erscheinung bei einem anderen Haar (Vakuolenkontraktion). — 22, 23 Vakuolenkontraktionen in den Haarzellen nach Lebendfärbung und Plasmolyse. — 24 Überlebende Tonoplasten in einer Spitzenzelle. — 25 Plasmolyse und Vakuolenkontraktion nach Lebendfärbung in den Haarzellen einer blühenden Pflanze. — 27 Vakuolenkontraktion in den Epidermiszellen des Keimblattes nach Lebendfärbung mit Neutralrot. — 28 dieselbe nach Plasmolyse durch $^1/_2$ mol KNO_3. — 29 Epidermiszellen der Keimblätter nach Lebendfärbung mit Neutralrot geplasmolysiert durch $^1/_2$ mol KNO_3.

Sucht man Haare aus, die wenig von dem gelben Stoffe in ihren Spitzenzellen enthalten, so kann man Vakuolenkontraktion auch ohne Plasmolyse erhalten (Fig. 19), besonders als man minder reichlich färbt. Es ist aber auch hier, zumindest bei einem Teile der farbstoffspeichernden Protoplasten, ein gelblicher Ton der Farbe feststellbar gewesen. Die Plasmolyse verläuft gänzlich so, als es oben beschrieben wurde, durch die Plasmolyse sterben aber hier zufällig mehrere Zellen kürzlich ab (Fig. 20). Die nach einer lang andauernden Plasmolyse im Leben bleibende Spitzenzelle zeigt, dass der Ton des durch die Plasmolyse noch mehr gekontrahierten Vakuoms in einen karminroten übergeht. Endlich konnte ich eine Dehnung des Protoplasts beobachten, sicherlich, da seine Semipermeabilität verloren ging. Gleichzeitig viel des gekontrahierte Vakuom auch in kugelrunde Teilchen auseinander (Fig. 21). Sehr kürzlich nach diesen Erscheinungen platzte die Plasmolemma und der Tod war eingetreten.

Die Neigung der kontrahierten Vakuolen der Spitzenzellen, um bei länger andauernder Plasmolyse in kugelrunde Gebilde zu zerfallen, konnte ich bei anderen Haaren mit allerlei Zwischenstadia beobachten. Die Fig. 22 und 23 stellen zwei der gesehenen Fälle dar.

In einigen Haaren ging die Desorganisation des Plasmas schneller, als die der Tonoplasten. In solchen Zellen konnte ich das Platzen der Plasmolemma und vollkommener Zerfall des Plasmas gut folgen, die Tonoplasten sind aber noch »lebend» geblieben. Manchmal konnte ich diese »überlebenden» Teile des Vakuoms (d.i. die polymolekulären Tonoplasten) fast unverändert zwischen den Trümmern des Plasmas noch 20—40 Minuten lang weiter beobachten. Es ist aber eine minimale Veränderung in dem osmotischen Druck der Umgebung (Deplasmolyse-Versuche) genügend gewesen, um eine unmittelbare Platzung der Tonoplasten zu verursachen. Solang die Gebilde intakt waren, konnten aus ihnen keine Farbstoffmolekülen austreten, da die Intensität der Färbung unverändert blieb (Fig. 24). Diese Intensität ist aber nicht in allen Vakuolenteilen dieselbe gewesen.

Die bisher beschriebenen Untersuchungen habe ich an Haaren der Keimpflänzen ausgeführt. Die Verhältnisse waren aber auch in den Haarzellen entwickelter Pflanzen die selben. Da konnte ich es auch immer feststellen, dass die Farbstoffaufnahme in der ersten Linie in den Spitzenzellen die grösste ist. Die sehr kurz andauernde Färbung des Haars, das auf der Fig. 25 dargestellt wurde, ist genügend gewesen, um eine Vakuolenkontraktion zu verursachen. In die anderen Zellen ist praktisch kein Farbstoff eingedrungen, so dass diese gewöhnliche konvexe Plasmolysen aufweisen.

Bei einem länger andauernden Färbungsversuch habe ich immer genau dieselben Verhältnisse gefunden, die ich auch bei den Haaren der Keimpflänzchen beschrieben habe. Eine Ausnahme bilden die Haarzellen, bei welchen eine sehr reichliche Anhäufung des gelben Stoffes in den Spitzenzellen sichtbar war. Hier konnte ich niemals eine Farbstoffaufnahme beobachten, im Gegensatz zu den anderen Zellen des Haars, die meistens reichlich Farbstoff gespeichert haben. In den Zellen ist durch Plasmolyse eine Vakuolenkontraktion entstanden, die in allen Hinsichten mit den bereits beschriebenen identisch war (Fig. 26).

Eine merkwürdige Erscheinung konnte ich bei den Epidermiszellen der Keimpflanzen beobachten. Durch reichliche Farbstoffaufnahme entsteht auf in diesen eine mehr oder minder ausgeprägte Vakuolenkontraktion (Fig. 27). Plasmolysiert man die so vergifteten Zellen, so entstehen in ihren Vakuolen kleinere, kugelförmige, sich noch mehr zusammenziehende Körper, die einen tieferen Farbton aufweisen. Diese Tröpfchen oder innere Vakuolen (?) oder sekundäre farbstoffspeichernde Organellen (?) sind mit einer stark lichtbrechenden Hautschicht umgeben, die von den bereits beschriebenen »polymolekulären» Tonoplasten nicht zu unterscheiden sind (Fig. 28). Aehnliche Gebilde konnte ich manchmal auch in stark vergifteten Zellen der Epidermis des Stengelchens beobachten (Fig. 29), die ich aber ausschliesslich in der Nähe der Schnittwunden — wo die Farbstoffaufnahme reichlicher war — feststellen konnte.

Zusammenfassung.

1. Die Aufnahme und Speicherung der gebrauchten Farbstoffe (Methylenblau und Neutralrot) geht mit Inaktivierung gewisser Mizellen des Plasmas und wahrscheinlich auch der Vakuolen gepaart, so dass man richtig nur über eine Vergiftung und nicht über Speicherung sprechen kann.

2. Die farbstoffbindenden Molekülen (Mizellen?) sind nach der Art des Farbstoffs verschieden, da sie in gewissen Fällen das Protoplast verlassen können (Haare mit Methylenblau gefärbt), in anderen aber trotz einer Plasmolyse in den Protoplasten bleiben (Neutralrot in allen untersuchten Zellen, Methylenblau in den Zellen der Wurzelhaaren). Die verschiedenen Sorten der Zellen verhalten sich in dieser Hinsicht verschieden.

3. Es ist gänzlich unsicher, ob die gesehenen »polymolekulären» Tonoplasten wirklich von den normalen Tonoplasten der Zellen abkomstig sind.

4. Durch die Inaktivierung der farbstoffaufnehmenden Molekülen (Mizellen) des Plasmas entsteht eine ungleichmässige Verteilung der Viskosität.

5. Die Plasmolyse nach einer Lebendfärbung ist nicht nur von dem gebrauchten Farbstoff, aber auch von dem verwendeten Plasmolytikum abhängig. Die

Verschiedenheiten sind der verschiedenen Intrameabilität der Plasmolytika zuzuschreiben.

6. Einzelheiten über Tonoplasten, Vakuolen — die nach Lebendfärbung wahrscheinlich nicht identisch mit den normalen Vakuolen der Zellen sind — und Zellkerne siehe den Text.

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A contribution to the knowledge of the development of the aerophile Chlorophyceae.

By T. Hedlund.

Introduction.

The method of research that was used in the investigation of the hereditary differences appearing in the aerophile *Chlorophyceae* forming part of the organization of the lichens, dated its origin from attempts at grouping the crustaceous lichens belonging to *Lecidea* in a wide sense, on the basis of anatomic similarities as to hereditary qualities in their thallus and apothecia. The largest group consisted of the lichens given the generic name *Micarea* in 1892 (Appendix to K. Svenska Vet.-Akad. Handlingar [Transactions of the Royal Swedish Academy of Sciences]. Vol. 18. Part III. Nr. 3, p. 27, 75—97). This name was given by E. Fries in 1825 (Syst. orbis veget. I, p. 257) to one of these lichens, viz. *Micarea prasina* Fr.

This new-formed genus included species having a considerable number of qualities in common. Already at an early stage of development their apothecia lacked the margo that may be produced by the parathecium situated around the thecium. The parathecium was found to consist of hyphae having the same form and situation as the paraphyses of the thecium. The latter were threadlike and in their apex lacked the dilatation often found in other *Lecideaceae*. This anatomic similarity in the hyphal tissue of the thecium and the parathecium is probably the cause of the complete lack of margo around the thecium from the very first appearance of the apothecium. The hyphae are longicellular, and hence there is no pseudoparenchymatic bark layer. Nor are any other layers to be observed, and the thallus of a *Micarea* is thus homeomeric. According to investigations published in 1892, the hyphae within the thallus were connected with the algae by means of haustoria, but better knowledge of this has been obtained later by crushing a living thallus, thus making these algae emit their plasmatic

contents. Inside the membrane of many of them a hyphal branch was observed that was thin and of uniform thickness all the way to its apex and thus in the capacity of haustorium had been deeply enclosed in the protoplasm of the alga.

Similar examinations of the thallus of other lichens proved that haustoria were also to be found in some of them, but not in connection with the combination of qualities characteristic of *Micarea*. The form of the haustoria was also different inasmuch as their thickness increased towards the apex. Furthermore, the lichenous alga with which they were combined was also of another species than that found in *Micarea* and characterized by the fact that in a pure cultivation under natural conditions it produced elongate individuals and not ball-shaped ones in the thallus. A brief account of this algal species will be given further on in the present work.

The qualities mentioned of the thallus, apothecia and alga of the lichens belonging to the genus *Micarea* together constitute the most important characteristics distinguishing them from other crustaceous lichens. Their spores present no qualities that distinguish this genus from other *Lecideaceae*. Some species have simple and 1-septate spores that may be developed in the same apothecium. In some other species 1—3-septate spores occur mixed. Also 5-septate spores may be found to a small extent besides 3-septate spores. These differences presented by the spores have no connection with the corresponding differences as to the development of the thallus and the apothecia. The septation of the spores may be highly different in a couple of species that for the rest are so alike that it is hard to distinguish between them. The differences between the species of *Micarea* are given in the systematic survey published in 1892 in the journal mentioned above, p. 75—84.

Investigations.

In the course of the investigations into the organization of the lichens performed before 1892, the need was also felt of ascertaining the nature of the difference between the obviously different algae forming part of their thallus. The method of investigation generally used in order to define the alga present in the thallus of a lichen consisted in producing a pure cultivation of it and observing the successive stages of development presented by the various individuals. A comparison between these gave a certain knowledge of their development. The lichenous thallus used for pure cultivation of the alga had to be free

from cephalodia and fissures that might contain other algae than those looked for. In the beginning, the lichenous alga most frequently subjected to these investigations was that present in *Xanthoria parietina* (L.) TH. FR. The surfaces of a piece of the lichen thallus was washed scrupulously clean, after which is was crumbled into minute particles while in a moist condition, so that it could be spread out for cultivation. The substratum most suitable for this was an object glass, on which the crumbled thallus was spread with the algae, which were dried slowly in a favourable light. In order to secure a development under conditions similar to those under which they grow in free nature, a glass bowl was used with a layer of water on the bottom and above this a metal net, on which the object glass with the algal layer was placed at an inclination with the aid of a support, the algal layer being turned towards the southern part of the sky but protected against direct sunlight in order to prevent too rapid and intense drying. The lid of the glass bowl was put on in order to make the algae dry slowly. The algal cultivation was watered every morning with a sufficiently diluted nourishment solution, which was prepared out of a solution containing on 1 liter of distilled water 12 g $Ca(NO_3)_2+4\,H_2O$, 3 g KNO_3, 3 g $MgSO+$ $+7\,H_2O$ and 3 g K_2HPO_4. A small volume of this solution was diluted with distilled water to at least 20 times its volume, thus 5 cm^3 at the most to 100 cm^3. No addition of an iron compound to the nourishment solution was necessary. In order to prevent the solution added to the algal cultivation from giving rise to an unduly strong concentration of its salts, the superfluous amount of the solution was blown away. The algae were not swept away by this, as they adhered so strongly to the substratum after one or two dryings that not even watering of the algal layer by a squirt of the solution could tear them away, as it did the spores and cells yielded as a consequence of the watering. The results demonstrated in fig. 1 and 2 were obtained from such pure cultivations of this alga.

In fig. 1 are shown 2 of the algal individuals in these cultivations that had not yet undergone any division in their interior. They were all ball-shaped and presented within the membrane a thin layer of protoplasm containing a small amount of very tiny oil drops. It has been ascertained by means of osmotic examinations that it has a plasma skin close to the membrane. There was a large chloroplast inside the protoplasm, and the nucleus of the cell was situated in a depression in the chloroplast, outwardly adhering closely to the plasma skin. It contained a nucleus. The contents of the chloroplast could best be observed

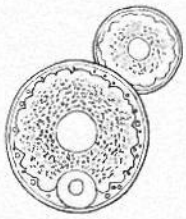

Fig. 1.

when iodine dissolved in a potassium iodide solution was added to the alga. The solution generally used consisted of 1 g iodine and 1 g potassium iodide in 100 cm^3 of water. A strongly conspicuous pyrenoid was observed in the middle of the chloroplast, closely surrounded by a thin and coherent starch layer. There were numerous small starch grains around this layer, the more sparse the further out they were situated.

In the cultivations of this alga an abundant multiplication by division took place in a way characteristic of this alga. The 3 different kinds of division observed in the cultivations are demonstrated in fig. 2. There was no division of an algal individual into 2 new individuals, but only into 4, 8 or 16. Evidently the new individuals originated from as large a number of cells as that into which the mother individual had been divided. If this number was 4, each cell had three inward-turned plane sides bordering upon the other three cells and one outward-turned curving side originating from the mother individual. The combinations of 8 cells were the most common ones in the cultivations. In these there was observed a relationship between the cells as to their positions which is shown most clearly by the three 8-cell combinations situated furthest to the left in the figure. Uppermost in relation to the substratum there are 4 cells, 2 of which are situated close to each other. The partition between these two cells is in the middle, as is seen in the figure. Each of these two cells is surrounded by 5 cells, whereas each of the other two cells is surrounded by 4 cells. This applies also to the 4 cells situated under them on the substratum. In the combinations of 16 cells, 1 cell is situated in the middle, surrounded by the other 15 cells. To the right in fig. 2, one of the cells in a 16-cell combination is situated on the top surrounded by 6 cells, each of which borders upon 5 of the surface cells. In the figure, the hidden membranes of all the cells situated under these $(1+6=)$ 7 cells are finely dotted. The middle cell is situated immediately under the topmost cell, with 2 cells under it on the substratum. 6 cells are situated around these 2. The number of cells in this combination is thus $(1+6+1+2+6=)$ 16. An examination of the cell divisions with 4, 8 and 16 cells shown in the figure reveals the number of their partitions to be 6, 18 and 54 respectively. A doubling of the number of cells thus made the number of partitions between the cells threefold. Furthermore, in pure cultivations of this alga the number of cells developed and established as

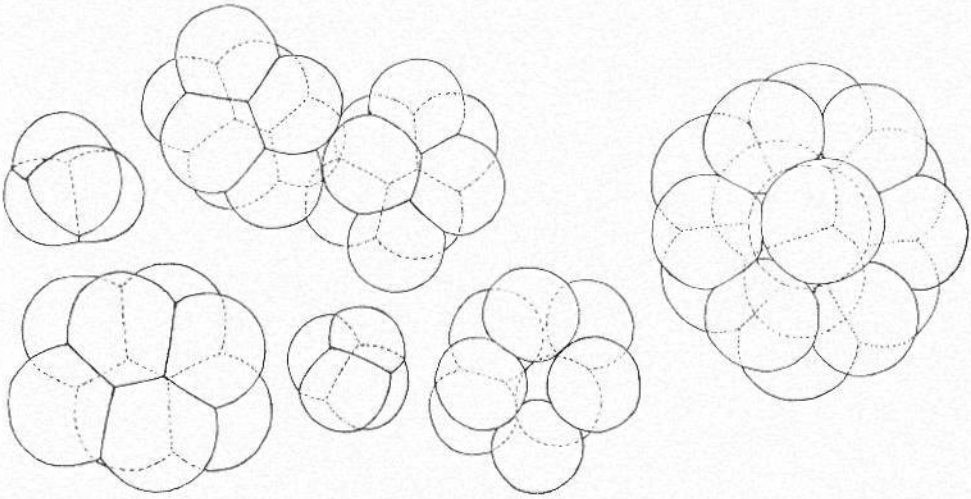

Fig. 2.

new individuals was observed to increase in proportion to the increase of the size of the individual forming the starting-point of the division.

Comparisons between algal individuals proved clearly that a division of the contents had taken place before the development of the cells, but also that these observations could not be made sufficiently exact to supply the desired information as to the development of the form of the cells and their positions in relation to each other in the various combinations. These unsatisfactory results of observations of pure cultivations awakened a desire to follow these divisions in each separate individual. Change of form also occurred frequently in the algae examined. Each case of this kind demanded an investigation into its cause as well as into its way of development.

The continuous observation method.

As the algae had proved to adhere so strongly to the substratum used in the investigations already after a few slow dryings that they were not torn away by watering of the cultivation, it was possible to follow the development of each of certain selected individuals by microscopic examinations performed as often as was required. Reagents could not be used in these examinations but only when different individuals in a pure cultivation were to be compared to each other. But in observations of the development of separate individuals, the external

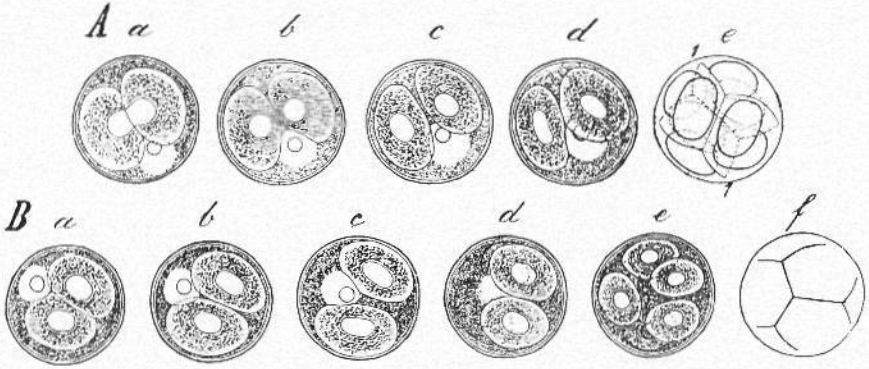

Fig. 3.

conditions, such as the light, the temperature and the composition of the nourishment solution, could be changed when required. The most suitable substratum in these cultivations was an object glass. In the middle of the glass, where the cover glass was to be placed in microscopic examinations, a few crossed lines were applied in jet-black (chinavarnish), having the same length as the cover glass and with intervals between them of $^1/_4$ of the length or about 5 mm. The jet-black was made solid by heating and formed black lines, which were made even by scraping with a straight and sharp glass edge. The algae, moistened with the diluted nourishment solution, were placed on the small squares between the black lines, and the cultivations were treated in the same way as those mentioned above forming the material of fig. 1 and 2, only instead of a glass bowl a drinking-glass with a little water on the bottom was used, and above this a metal net on which the object glass with the culture was placed. A light cover was applied in order to prevent too rapid and intense drying.

After a few days of cultivation certain areas were selected presenting algal individuals in positions favourable to continuous observation of their development. The areas selected were reproduced on paper, slightly enlarged, with the aid of a camera clara. These areas were preferably selected near the black lines in order to make it easy to find them again. Furthermore, the distance could be measured between the field of view, within which the chosen area was situated, and an easily recognizable line situated near-by, and this distance could be expressed by the number of the intervening fields of view. After focussing on one of the areas thus determined, the stage of development reached by certain individuals was reproduced at so high a degree of

magnification that the details observed and reproduced by aid of the camera clara were magnified about 1300 times. In this way the following figures were obtained in pure cultivation of the lichen present in *Xanthoria parietina*.

Fig. 3 shows the processes by which two individuals A and B gave rise to a new individual by division. In A, the chloroplast at a was divided into two parts inwards to the pyrenoid on September 27 at 11.15 a.m. The pyrenoid had also prepared its bipartition, which was complete at b at 1.45 p.m. The nucleus now moves in between the two chloroplasts with its nucleolus displaced forwards in the direction of the movement, and it continues to do so at c at 4 p.m. and at d at 6.15 p.m. The extension of the pyrenoid in each chloroplast implied the preparation of a bipartition. Divisions took place repeatedly in the night, and at 7.45 a.m. four chambers separated by plasma membranes were to be found at e. The plasma membrane 1—1, found at the first nucleus division, is averagely situated in the same direction as the division plane between the 2 chloroplasts first formed, but this plasma membrane was divided into four planes by the two formed at the bipartition of the two nuclei. Four chambers had thus been formed, divided by 6 plasma partition-walls. There were two chloroplasts and one nucleus in each chamber. If the division of the chloroplasts had stopped at the number of 4, the division of the nuclei would also have stopped at this number, whereupon cellulose partition-walls would have been formed and a four-cell combination come into being. But the size of the mother individual caused the divisions to continue, and when they stopped, on Sept. 29, 16 cells had been formed.

The divisions that had taken place here before the formation of the cellulose partition-wall may be characterized as protoplast divisions. By protoplast, HANSLEIN (1880) meant the plasma body situated behind the membrane with its content of plastids, and it is this body that has undergone divisions. Cellulose was not formed in the plasmatic partition-walls until these divisions had been completed. The form of the completed cells thus depends primarily on the form obtained by their protoplasts in the protoplast division. Their subsequent change of form depends upon their growth. The cells would have had another form, if a membrane of cellulose had been formed before the following division at e in the plasmatic partition-wall first formed, 1—1 in fig. 3 A. In that case it would have remained plane when the following two partition-walls were formed, and the form of the cells would have been determined exclusively by the growth. Such is the case in *Cystococcus*

humicola NAEG., *Pleurococcus vulgaris* MENEGH. and several other *Chlorophyceae* in their multiplication by division.

The protoplast in question makes its presence clearly felt also in the individual B in fig. 3, which was somewhat smaller than A, for which reason its divisions ceased after the formation of 8 cells. Its chloroplast had been divided into two parts at a at 8 a.m. on Sept. 28. At noon the same day the nucleus had started moving in between the two chloroplasts at b. At 4 p.m. these were nearing a bipartition at c, and this division was complete at d at 5.45 p.m., when also the nucleus was being divided into two parts between the 4 chloroplasts. Each pair of chloroplasts thus had a nucleus between them. Then followed the divisions observed at e at 8.39 p.m. on Sept. 29. There were then 8 chloroplasts and 4 nuclei. One of the latter was situated between the two chloroplasts that had been formed by bipartition of each of the 4 earlier chloroplasts. At 8.25 a.m. on the following day the 4 nuclei had been divided at f, and cellulose partition-walls had been formed in the plasma walls between the 8 cells.

In individuals of this alga that are smaller than B in fig. 3, the division of the chloroplasts stops already at the number of 4. The four cells thus formed were separated by 6 partition-walls of the same size and form. They were formed in the following way.

Observations of the protoplast division showed that 4 out of the 6 partition-walls were parts of the partition-walls first formed. The latter had been bent in 4 planes, where it was connected with the following 2 partition-walls. The cause of these bendings was that the partition-walls consisted only of plasma, which was stretched in the partition-wall first formed and contracted in the two following ones. This process is clearly distinguishable in fig. 4 at d, where the partition-wall formed first is designated 1—1 and the following two are designated 2.

A protoplast division that took place in a considerably larger individual than A in fig. 3 did not stop for formation of cells but continued to formation of spores, which developed into zoospores in the individual shown in fig. 4. In a case of this kind it was easier to observe the process of protoplast division in its initial stage. In fig. 4 a the chloroplast had been divided into two parts, and the nucleus was divided into two parts after the bipartition of the two chloroplasts at b on the following day. The two nuclei thus formed found their way separately into the pairs of chloroplasts, as is shown by their nucleoli in the figure. Between the two nuclei there had been formed a plasma membrane 1—1, which was connected with the plasma skin situated close to the membrane after

having grown outwards. Within 4 hours the nuclei as well as the chloroplasts were divided at c and d. The partition-wall formed first, consisting of plasma and being situated in one plane, had been divided into 4 planes at d 1—1 by the two plasmatic membranes formed at the division of the two nuclei. The 4 protoplasts now formed had thus 6 partition-walls, 4 of which were parts of the partition 1—1 first formed.

The protoplast division continued in this way and made the mother individual contain a great number of protoplasts, which were, according to numerous investigations, emitted as zoospores under normal conditions. The zoospores were egg-shaped and provided with 2 cilia. After having swum around for a little while they tried to get into the space under algal individuals lying closely, and having got in they continued their development. This explains why in free nature this species of alga could be found under the loosened epidermis of foliiferous trees and often also under thin layers of other green algae on the trunks of the trees.

A copulation was sometimes observed between a couple of the abundantly swarming zoospores in a pure cultivation of this alga. They placed their plane sides against each other and tumbled about together, whereupon they combined into one spheroidal individual. To start with, a border between them could be noticed in a plane within this new individual, but it disappeared within 6 minutes and the volume was rather heavily decreased. The two chloroplasts remained separate, but it was evident that the nuclei combined in connection with the disappearance of the border. The new individual had reached its minimum size after another 15 minutes It now clearly presented 1 nucleus and 2 chloroplasts in its interior and henceforth grew normally.

An individual with two chloroplasts was sometimes observed in cultivation of this alga. Continued observations of this individual showed that it was not a case of a commenced division, as was also to be inferred from the position of the nucleus close to the membrane between the two chloroplasts, not with an advanced nucleolus trying to find its way in between them.

Under certain conditions this alga yielded its spores in the shape of aplanospores instead of zoospores. After a period of rain, a cultivation of this alga was commenced, starting from a tiny layer of the alga taken from the bark of a birch. A surprising phenomenon was observed in this cultivation. An individual that had finished its protoplast division

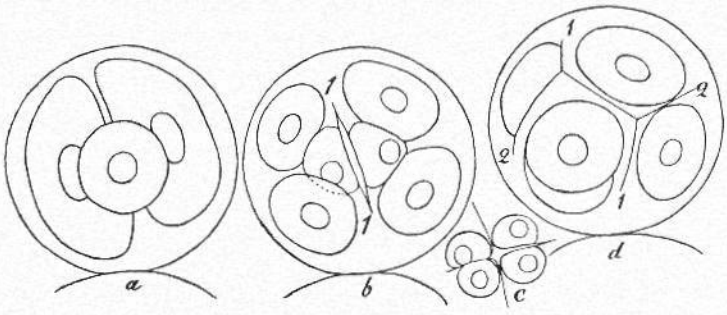

Fig. 4.

for the formation of spores emitted aplanospores instead of zoospores. Each of the small protoplasts had surrounded itself with a cellulose membrane already in the interior of the mother individual. This phenomenon is to be connected with a soaking of the nourishment substances on the surface of the bark by frequent rains. As a consequence of this, the amount of nitrogenous nourishment formed was smaller than the amount of carbohydrates, the latter being formed by carbon-dioxide assimilation. It is possible that an accumulation of carbohydrates caused the protoplasts to be provided with a cellulose membrane before they were emitted as spores. A similar phenomenon observed in this alga will be related in the following, where it is also connected with decreased ability to form nitrogenous nourishment.

This species of alga is easily recognizable by the simultaneous formation of 4, 8 or 16 cells, which are then separated as new individuals. It should therefore have a name of its own. A. ARTARI, who had performed nutritional physiology experiments with the lichenous alga of *Xanthoria parietina* (L.) TH. FR., declared it to be identical with *Chlorococcum infusionum* MENEGH. This name had been given to a Chlorophycea formed in stillstanding water. The lichenous alga in question has also been declared to be *Cystococcus humicola* NAEG., which is, however, characterized by quite another development, which will be related in the following. As the aerophile *Chlorophyceae* were and still are insufficiently known as to their development, a satisfactory generic classification of them was lacking. Therefore the alga concerned could not be designated by a distinguishing generic name. *Protococcus* was a usual name of some green algae, and therefore the alga easily cultivated pure out of the thallus of *Xanthoria parietina* was given the name *Protococcus Xanthoriae*. It is characterized by the following qualities.

Individuals developed free are ball-shaped. There protoplast generally possesses only one chloroplast, rarely two. In the middle of the chloroplast there is a strongly developed pyrenoid immediately surrounded by a continuous starch layer, and outside this by small starch grains getting more sparse towards the outside (fig. 1). A special characteristic of this species is the simultaneous appearance of 4, 8 or 16 cells after a preceding protoplast division determining the form of these cells, which are separated during their growth and form new individuals also including the membrane of the mother individual (fig. 2). In large individuals the protoplast division goes on to the formation of a great number of spores, which under favourable conditions are emitted as zoospores. If the ability of the alga to form nourishment is decreased, which makes it poorer in carbohydrates, the spores obtain their cellulose membrane already in the mother individual and are emitted as aplanospores.

Protococcus Xanthoriae proved to be an alga widely spread in nature. It was very common on tree trunks. In an investigation into its presence on some very old and high elms that had been felled it was found also on some of the top branches. It was found there e.g. under loosened epidermis. It was also found to form part of the thallus of many lichens belonging to *Usnea, Evernia, Ramalina, Cetraria, Parmelia, Physcia, Xanthoria, Caloplaca, Rinodina, Lecanora, Buellia* and several other crustaceous lichens. In pure cultivation out of the thallus of a lichen, its growth was more or less weakened in the beginning. The weakness of the growth was ascertained by comparison with individuals of the same species that had been adapted to receiving its nitrogen from an inorganic compound, as in free-growing condition. Comparisons were made as to the diametrical growth of individuals of approximately the same size while developed in different areas of the same object glass, the external conditions of growth thus being the same. The investigations performed by A. ARTARI and published in 1902 (Ber. d. deutsch. Bot. Ges. XX, p. 174) proved that this alga had been adapted in the hyphal tissue of the lichen to receiving an organic nitrogen compound, wherefore, according to ARTARI, it preferred peptone nitrogen to nitrate nitrogen, to which it was adapted in its free condition. The method employed of cultivating aerophile algae in air showed that a lichenous alga of this kind could be adapted to receiving nitrate nitrogen. This adaption was facilitated by the lichenous algae being prepared for cultivation together with the crumbled hyphae of the lichens, from which they could receive organically

bound nitrogen in a decreasing amount. This modification of the vital functions of the algae took place more or less easily depending upon the species of lichen forming the starting-point of the algal cultivation. Incipient nitrogen deficiency in the algae made itself apparent by accumulation of oil drops in the cytoplasm around the chromatophore as a consequence of a decreased consumption of the carbohydrate still formed by carbon-dioxide assimilation. There were also lichens whose alga was dead throughout the entire cultivation withing two days, when it had been prepared for cultivation after minute crumbling of the lichen thallus together with the crumbled hyphae, but it could be adapted in the way mentioned if pieces of such a lichen thallus were first kept for some time in the nourishment solution used. In one of the experiments with such a lichen the pieces were removed after 8 days, after which they were crumbled and prepared for cultivation. The algae proved to have adapted themselves sufficiently to receive the necessary nitrogen out of nitrates and grow satisfactorily.

In pure cultivation of lichenous algae of this species, the algal individuals that developed to formation of spores generally emitted these in the shape of zoospores, but there were exceptions. In pure cultivation of the alga present in *Ramalina farinacea* (L.) ACH., it proved, it is true, to belong to this species, but the individuals that had undergone protoplast division to formation of spores yielded these in the shape of aplanospores. It was mentioned above that this phenomenon could also occur in this alga growing free after a long period of rain. In both cases the cause seems to have been an increased amount of carbohydrate caused by decreased supply of nitrogen for the formation of albumen under consumption of carbohydrate. The increased supply of carbohydrate thus seems to have caused the spores to be provided with a cellulose membrane already in the mother individual.

The alga present in *Cladonia* and *Stereocaulon*, which might suitably be called *Protococcus Cladoniae*, is very closely related to *Pr. Xanthoriae*. As to the formation of the protoplast it was so alike the preceding species that it was hard to distinguish from it, but its development presented considerable dissimilarities. It lacked the division, characteristic of *Pr. Xanthoriae*, into 4, 8 or 16 cells, in the separation of which into new individuals also the membrane of the mother individual formed part (fig. 2). In the corresponding division of the protoplasm of the mother individual in *Pr. Cladoniae*, the protoplasts formed were provided with cellulose walls, which were cleft within the membrane of the mother individual and could be emitted as aplano-

spores after having grown more or less on their place of formation. In large individuals the protoplast division also of this alga under favourable conditions ended in formation of zoospores. If this was not the case, the ready-formed protoplasts were emitted as aplanospores as in the preceding species. To the difference between these algae may be added that *Pr. Cladoniae* is less hardy against rapid and intense drying. Already the fact that lichens belonging to *Cladonia* and *Stereocaulon* were found nearer the ground gave a hint of this. On the trunks of the trees *Pr. Xanthoriae* could develop freely at a considerable height above the ground, but *Pr. Cladoniae* was not found here.

As to the development of the protoplast, these two green algae bore a certain resemblance to *Cystococcus humicola*, which has been described and depicted by C. NÄGELI (Gattungen einzelliger Algen. 1849, p. 84, Tab. III E). This alga was found rather commonly on moist earth and on tree-roots in parks and woods, but it was not found in any of the numerous lichens examined as to the species of alga contained in them. It differed from the two preceding algae especially as to its way of forming cells. After each nucleus division a cellulose partition-wall developed in the plasma membrane formed between the two protoplasts. Under these circumstances the cells assumed quite another form than when cellulose partitions were not developed until after the completion of two or more protoplast divisions following upon each other, as was the case in the two preceding algae. The difference is most easily observed at the second nuclear division. If the cell wall first formed consists of cellulose, it remains plane when the following two partition-walls are formed. Each of the four cells then had two plane inward-turned sides, not three as in the two four-celled individuals in fig. 2, where the partition-wall first formed still consisted exclusively of a plasma membrane when the second nuclear division took place, whereby it was parted into four planes by the two additional plasma membranes. Six partition-walls of the same size were thus formed between the four protoplasts. In the continued protoplast division the protoplasts formed were of a somewhat rounded form because the plasma membrane surrounding each of them exhibited a tendency to contract. This was not the case in the cell formation of *Cystococcus humicola*. In this alga a cellulose membrane had been formed in the partitions between the cells already before the following nuclear division. This membrane marked the borders between the cells more clearly than when the partitions between them consisted only of plasma membranes. In the figures given by NÄGELI in his account of this alga

they are seen clearly in several individuals. In cell division of this kind the cells were more or less elongate, which could best be noticed here and there in individuals with completed cell division for formation of spores. They were not emitted as zoospores but always as aplanospores, the form of which depended upon the form assumed by the cells in the mother individual. In a cultivation where the air humidity coincided closely with the conditions on the place of growth of the alga, aplanospores that were very different from each other as to their form were emitted from one and the same individual. Some of them were approximately ball-shaped, others being more or less elongate. Out of the numerous spores remaining in the cultivation, adhering to the substratum after the drying, the ball-shaped ones produced individuals of the same form as the mother individual. The most elongate ones continued their growth, increasing in length as well as in thickness, but after having reached a certain size they continued their growth only in the length direction simultaneously with cell division. They then became completely alike the thread-shaped aerophile algae known under the name of *Hormidium parietinum* KÜTZ. and also found at and below man's height on the trunks of many old trees in the district where *Cystococcus humicola* was found here and there on large tree roots emerging from the nothern side of the trunks, protected against strong sunlight. The less elongate aplanospores grew in length as well as in breadth simultaneously with cell division, whereby laminae appeared resembling *Prasiola crispa* (AG.) MENEGH. Besides these three forms numerous intermediary forms were found. A small lamina consisting of a few cells sometimes continued to grow in one direction into resembling a ribbon. A form change could also consist of a cleavage of the partition walls in such a way that the separated parts obtained another form in their subsequent growth than that from which they derived their origin. The experiments performed presented no instance of a change of form in the opposite direction to those mentioned. The *Hormidium* threads were cultivated under varying external conditions, and in some of the experiments they were also split into separate cells, but no spore-forming cells appeared in these experiments. It seemed that they could have no other origin than the elongate aplanospores that could be emitted by *Cystococcus humicola*. Such changes of form appeared in several other aerophile green algae whose development were made the object of investigations. They often appeared without any external influence, thus being determined exclusively by the hereditary qualities of the organism, which exercised a regulating

influence on its development. But the cause could also be a change in some of the external conditions influencing the vital functions of the organism. The modification of form thus appearing could last also under changed conditions. If, however, it was changed back into the earlier form, it was comparable to the changes that may appear in higher organized plants through the influence of variations in the external conditions important to their vital functions.

These changes of form, which are highly different from those touching hereditary qualities as to their origin and nature, were termed modifications by C. NÄGELI in 1884. The change of form caused by them may be permanent or change back again. The modification may thus be stable or labile. The stable modification was termed Dauermodifikation by V. JOLLOS in his account of investigations into the development of microorganisms (Zschr. Abst. u. Vererbungslehre, 12, p. 14—35. 1914). These different kinds of modifications are found also in higher organized plants. According to E. BAUR (Vererbungslehre. 1914. p. 60—61. 1930. p. 57), a certain kind of treatment could make a branch of a young *Hedera helix* assume a form that remained unchanged in vegetative multiplication of various kinds but not in multiplication by its seeds.

In plants that multiply by seeds (formed sexually or vegetatively) it is easy to ascertain whether a discrepancy between them is hereditary or due to modifications. Seeds were collected from plants clearly differing from each other and the plants originating from them were made to grow under the same external conditions; if the plants became alike, the differences observed in the mother plants were evidently due to modifications, i.e. caused by external conditions influencing their development. This test could not be applied to the aerophile green algae. In their case, the only possible method of obtaining the desired information was continuous observation of the development of each particular individual. If spores emitted by algae in a cultivation developed differently from individuals in the same cultivation previously examined, this could be due either to the presence of different species of algae in the same cultivation or to a modification. No appearence of new biotypes had been observed in the course of these investigations. In a pure cultivation of a lichenous alga this problem was easily solved, but even if a pure cultivation was not at hand, because the alga had been taken from a place where different algae might grew together, it was easy to answer the question with the aid of a simple method that will be described in brevity.

In an algal cultivation it was desired to obtain knowledge of the development of the spores that were formed ready in an algal individual. The cultivation was left drying slowly till the following day, and then no nourishment solution was added for microscopic examination, but the cultivation was exposed to condensation of aqueous vapour supplied by breathing upon it. The emitting of spores as a consequence of this supply of water was observed microscopically at a small degree of magnification, so as to make the distance between the cultivation and the objective of the microscope long enough to prevent the appearance of a disturbing water film on the lense of the objective. When it was observed that the emitting of spores had commenced, the breathing on the cultivation was continued till a considerable amount of spores had been accumulated around the membrane of the mother individual. The cultivation was put back in its place without any nourishment solution being added, and it dried slowly, which should make a part of the spores adhere to the substratum. The cultivation was examined microscopically on the following day and provided with nourishment solution. As expected, a good deal of the spores emitted adhered to the substratum around the membrane of the mother individual. Some of them were depicted with the aid of a camera lucida, and their development was observed for a sufficient length of time. They all resembled each other as to their form and development. They developed into short cylindric individuals having rounded ends and growing in the length direction and multiplied by bipartition in the middle. As to their form and size they resembled the alga described and depicted by NÄGELI under the name of *Stichococcus bacillaris* (Gatt. einz. Algen. 1849 p. 76. Tab. IV, G. 1). As none of the spores observed developed into the alga from which it derived its origin, it is evident that under other conditions this alga could produce offspring resembling the mother individual. But it was impossible to ascertain the nature of these conditions, and therefore no information could be obtained as to the multiplication of this alga.

In these investigations into the development of the aerophile algae it was often difficult to obtain detailed knowledge of their modifications, as these took place simultaneously with the formation of numerous spores in large individuals of the alga. But if the mode of multiplication was simpler, knowledge of the modifications was easily obtained with the aid of the investigation method employed. Instances of this will be found in the following.

In the investigations of which the results are given in fig. 5, *Gloeocystis botryoides* (KÜTZ.) NAEG. was used, which algal form was described and depicted by NÄGELI in 1849 (Gatt. einz. Algen, p. 65. Tab. IV a—r together with another form designated s). This algal form is found above all in shady and moist places on old bark and putrescent wood. The form in which it occurred in such a place was quite different from that appearing in the cultivation method employed. It was briefly the following.

Small groups of algal individuals were found in envelopes in the form of membranes, generally 2, 4 or 8 in each group. Some of them were situated close to each other, others being more or less separated from each other by jelly that had been formed around the thin membrane of each of them. There also occurred single individuals with a thick membrane of jelly. These observations showed that the multiplication of this alga consisted in a protoplast division stopping at the number of protoplasts conforming with the number of new individuals in each group, after which the new-formed individuals were separated from each other in an increasing degree, thus becoming free.

This alga was cultivated under conditions that were made to conform as much as possible with those prevailing on a treebranch with algae growing on it. Their development was observed as soon as they had become firmly attached to the substratum by slow drying shortly after the beginning of the cultivation. The development of two of the cases observed is given in fig. 5. One of these concerns a single individual designated z above a. The other one applies to the two individuals designated y which are enveloped in the jelly membrane of the mother individual. This was their stage of development on May 3. Their stage of development on May 22 is given at b. The individual z, after a division of the protoplast into four parts, had produced 4 new individuals, which were approximately ball-shaped like the mother individual and provided with thin membranes without any surrounding layer of jelly. In y the individual seen to the left had died, whereas that seen to the right had remained undivided, but during its growth it had continued increasing its jelly layer.

The cause of this could only be that it received some substance necessary to the dead individual. The nourishment solution used in these cultivations contained all the inorganic salts rendering the growth of the algae possible, but evidently it did not contain the substance necessary to the formation of the jelly characteristic of *Gloeocystis*.

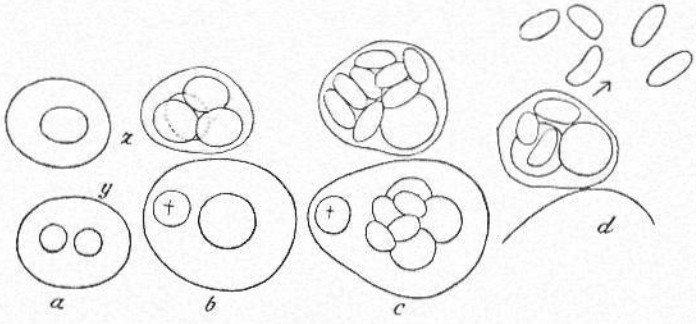

Fig. 5.

After another 9 days, on May 31, the development of these algal individuals had reached the stage indicated by the two figures above c. The upper one refers to the offspring of z. Observations during the preceding 9 days had shown the two top-most ball-shaped individuals in this case to have produced elongate individuals. A modification had taken place. 4 protoplasts, which assumed an elongate form and obtained a thin membrane, had been formed in each of the ball-shaped individuals by protoplast division. At first they were enveloped in a rest of the jelly membrane surrounding the individual z at c, but a short while after the stage c that seen above d appeared. 5 out of the 8 elongate individuals had been emitted through the bursting of the old membrane, but of the membranes of the two round individuals, in which the elongate individuals had been formed, nothing was left. They had consequently entered into the formation of the 4 cells, which were later separated as offspring, as in *Protococcus Xanthoriae*, in the divisions into 4, 8 or 16 cells reproduced in fig. 2.

The development of this alga shown in fig. 6 continued for some time, and observations were made that contribute to our knowledge of the cause of the above-mentioned modification, in which a ball-shaped protoplast produced 4 elongate ones by division. In fig. 5 at b, the individual z of this alga had produced offspring consisting of 4 ball-shaped individuals. 3 of these were situated above the fourth and developed more rapidly than the latter, because they received the necessary nourishment more freely. Each of the two individuals situated on the top, thus freer than the third one, had emitted 4 elongate descendants at c. Of the other two individuals, which are clearly visible at d, that situated to the right also had elongate descendants within the next few days. The individual situated to the left, however, behaved dif-

ferently, being the one most hampered in its development. It also had 4 descendants, but these were ball-shaped. This individual thus behaved in the same way as the ball-shaped one with a thick jelly membrane designated z at a. At b it is seen to have produced 4 ball-shaped descendants. The fact that these were not elongate is due to the effect of the thick membrane comparable to the superstratification of other individuals at d.

In all experiments with this alga, ball-shaped individuals produced elongate offspring if they were allowed to develop under conditions favourable to their preparation of nourishment and development. There is a physiologic discrepancy between the descendants of different form, constituted by the fact that elongation of the form implies an enlargement of the surface assimilating nourishment, which enables the individual to grow and develop more rapidly. Therefore, if the nourishment preparation of a ball-shaped individual of this alga takes place under favourable circumstances, their offspring assumes an elongate form, which is favourable to its nourishment-preparation and development. But if the development of the elongate individuals was hampered by their being accumulated or overgrown by other algae, they did not produce ball-shaped individuals. The modification in question into the elongate form is thus to be regarded as stable in this alga.

As to the inner structure of this alga, its protoplast proved to have 1 chloroplast, which was comparatively small to start with, extending over somewhat less than half the periphery of the membrane, but increasing its size during its growth faster than the individual as a whole, so as to occupy more than half the content of the full-grown individual. No pyrenoid was observed in the chloroplast.

In the investigations into the algae forming part of lichens, the alga found in various species of the genus *Micarea* proved to be this one, the result of pure cultivations of their alga being the same as in the cultivation of *Gloeocystis botryoides* (KÜTZ.) NAEG. In the thallus the algae were ball-shaped and unicellular in some cases, whereas in other cases they were divided into two cells. 4 elongate individuals with thin membranes were formed in each of these cells in pure cultivation of the alga. The strongly developed membranes of the lichenous algae did not enter into the development of their descendants, but were left burst by them. A haustorium of uniform slenderness was also observed in many of them. Of the new individuals, those formed first were less elongate than their descendants, the length of which could be three times their thickness.

In a herbarium material of algae belonging to *Micarea* and consisting on non-cultivable lichenous algae, these sometimes, however, bore a certain resemblance to the cultivable algae, and the species of this genus thus conformed with each other also as to the species of the lichenous alga, besides presenting certain resemblances as to the formation of their apothecia and thallus. *Protococcus Micareae* was therefore considered a fitting name for this algal species. It presents the following characteristics.

This alga is found in the thallus of the lichen in the shape of unicellular and bicellular individuals. The unicellular individuals are ball-shaped with a diameter of 4—9 μ. Their membranes are strongly developed, and in *Micarea prasina* FR. many of them are generally provided with a thin jelly layer in cases where this lichen is found in a place where also *Gloeocystis botryoides* is to be found. Each algal cell contains only 1 chloroplast, which has no clearly visible pyrenoid. In cultivation of this lichenous alga 4 new individuals, which are elongate, are formed out of each algal cell. Their formation is preceded by a protoplast division into 2 and after that into 4 protoplasts, which assume an elongate form and are provided with a thin membrane, into the formation of which the membrane of the lichenous alga does not enter. Each of these elongate individuals produces 4 new ones of the same form by division of the mother individual into four parts, the membrane also entering into the division. — This alga is found also in some other lichens, e.g. *Peltigera aphthosa* L. HOFFM.

An alga resembling this one in several respects was found in *Thrombium epigaeum* (PERS.) WALLR. and *Buellia parasema* (ACH.) *muscorum* (SCHAER.) TH. FR. It was also found in a form growing free in moist places, which NÄGELI connected with *Gloeocystis botryoides* (KÜTZ.) under the name of *Gl. vesiculosa* and depicted (Tab. IV s.), as was mentioned above. Characteristic of this algal species, which was termed *Protococcus Buelliae muscorum*, was a strongly prominent pyrenoid in the protoplast, which made it easily distinguishable from the last-mentioned *Protococcus*. As a lichenous alga it presented a development similar to that of the lichenous alga of *Micarea*. In the beginning of its cultivation, however, it sometimes occurred that ball-shaped individuals were developed with a membrane that did not enter into the formation of the 4 elongate descendants. The latter had thin membranes and multiplied by division into four parts in the usual way.

A good method in these investigations consisted in following the development of the algae on the bark of a birch. With a view to this,

Fig. 6.

a thin film of periderm, about 3 mm in breadth and 3 cm in length, was taken from a smooth part of the bark with algae growing on it. In the middle of this film an area was selected where the algae grew sparsely enough to permit observations of their development for some time. When the algae had been depicted with the aid of a camera lucida, the peridermal film was put back in its original place, and its two ends were carefully pressed on to the bark in a suitable way, the peridermal film thus reoccupying its natural position. It was generally taken out and replaced when the bark was wet from rain. Several peridermal films were generally required simultaneously in an experiment of this kind.

In one of the peridermal films there grew several algae subjected to observations. Two or these were forms closely related to each other; there development is shown fig. 6 and 7. They resembled *Protococcus Micareae* in some respects. Thus the individuals were in some cases elongate and in others ball-shaped, and in their multiplication 4 individuals were generally formed simultaneously after division of the protoplasts into four parts. Further, each individual had only 1 chloroplast, which did not possess any clearly visible pyrenoid. But important differences were observed in their development.

The development of two elongate individuals, 1 and 2, is demonstrated in fig. 6 at a, b and c (August 17, 22 and 26). At b, their protoplast had been divided into four parts, one of them l a r g e r than the other three. They all assumed an elongate form and were provided with a membrane, into the formation of which the membrane of the mother individual did n o t enter. At c, 3 out of the 4 new-formed individuals had been emitted, whereas the fourth individual remained inside the membrane of the mother individual. The new individuals had thus come into being as asplanospores. They possessed yet another quality not found in *Protococcus Micareae*. Their membrane, which was smooth to

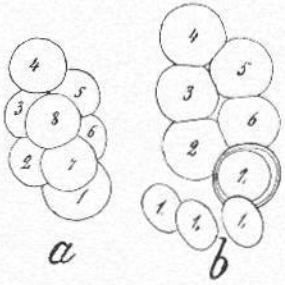

Fig. 7.

start with, became gradually tightly covered with fine warts on the up-turned side where the individuals were lying with free membrane surfaces. This way of reproduction was repeated not only by the offspring of the individuals 1 and 2, but also by other individuals of this species present on the same peridermal film. The large individuals always remained in a place inside the membrane of the mother individual situated opposite to the opening through which the others had been emitted.

In the beginning of these investigations, on July 24, a group of 8 individuals was observed lying close to each other in the order seen in fig. 7 at a. Their position in relation to each other revealed that an elongate individual had been divided into 8 cells after a protoplast division, after which cellulose partition-walls had been formed. Also the membrane of the mother individual had entered into the division, as was the case in the division of individuals of *Protococcus Xanthoriae* in fig. 2. At the cleaving of the partition-walls, the new-formed individuals had been kept together in unchanged positions in relation to each other. It was further a remarkable fact that they all were finely verrucose on their up-turned sides. Considerable similarities to the alga depicted in fig. 6 were thus at hand, but in the multiplication of the 8 individuals and their offspring a difference made itself apparent inasmuch as their descendants were not elongate, but ball-shaped. At b in fig. 7 (August 13), 4 spores had been formed in the largest individual 1. 3 of these had been emitted, whereas one, larger than the others, had remained inside the membrane of the mother individual. The three emitted spores were not fully ball-shaped to start with, but during their growth they soon became so. The same development was presented by the other 7 individuals during the subsequent observations. Evidently a change of the form of the alga had taken place through a modification in an elongate individual, making it produce ball-shaped individuals with otherwise unchanged characteristics. This algal form with ball-shaped individuals had also been found earlier on the same peridermal film together with the form characterized by elongate individuals. No change in the opposite direction, from ball-shaped into elongate individuals, as in *Protococcus Micareae*, was observed. But on the other hand there were certain resemblances to this algal species to be noticed. These resemblances were constituted by a division

of the protoplast into four parts before the simultaneous formation of four new individuals, and by the lack of a clearly visible pyrenoid in the chloroplast.

This algal species was found as a lichenous alga in *Lecidea lucida* ACH. In cultivation, its descendants kept the ball-shaped form they had in the thallus, but concerning the alga in the thallus of this lichen a remarkable observation was published by TH. M. FRIES in 1871 (Lich. Scand. p. 432). He had observed two algal forms in the thallus of the lichen mentioned, viz. on the one hand ball-shaped individuals and on the other hand elliptic or elongate ones. Possibly the algal form with elongate individuals had produced the form with ball-shaped individuals through a modification in the thallus of the lichen. If so, this modification was probably caused by the parasitism. The modification appearing in the cultivation of this lichenous alga was of a simpler nature and consisted in the membrane becoming finely verrucose on the up-turned side if the latter was lying free.

The primary characteristic of this alga, which may be termed *Protococcus Lecideae lucidae*, was its multiplication by 4 spores, as a rule, one of which was larger than the others and remained within the membrane of the mother individual. This spore-formation was also observed in the alga obtained through pure cultivation of the lichenous alga present in *Bacidia antricola* HULT. It differed from the last-mentioned species by a strongly conspicuous pyrenoid in the chloroplast, but was not made the object of detailed investigation. The algae characterized by this singular kind of spore-formation deserved to be united under the name of *Protococcus heterospora*.

Pleurococcus vulgaris MENEGH., in the meaning attached to this name by C. NÄGELI 1849, F. GAY 1891 and A. ARTARI 1892, is a widely spread aerophile chlorophycea. Its development is influenced in a high degree by varying humidity in its surroundings. In fig. 8 and 9 its development at man's height on the north-eastern side of a birch-trunk in Uppsala is demonstrated. The investigation was carried out in accordance with the method described above. Although the figures 8—10 have been published before (Kongl. Vetenskaps-Akademiens Förh. [Transactions of the Royal Academy of Sciences] 1899. N:o 5, p. 530—532), they are given here in order to facilitate a correct conception of this alga.

In fig 8, 4 stages of development a—d are demonstrated after an originally quadricellular individual at a. The observations were made in the year 1896, starting at a on August 23. After 12 days the number

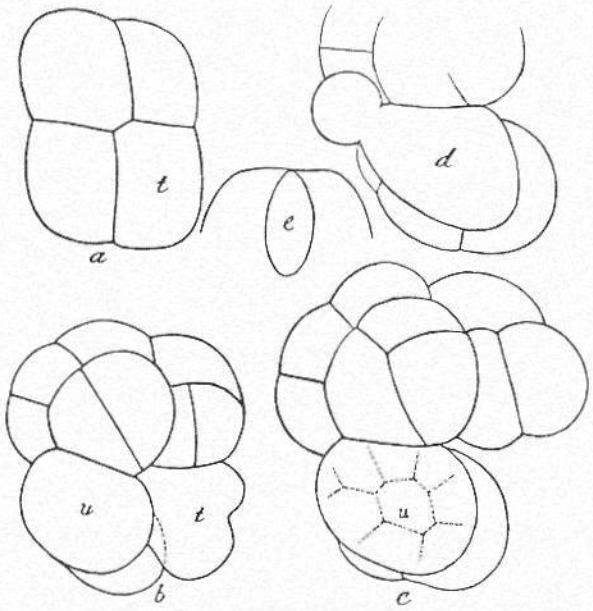

Fig. 8.

of cells had increased considerably, as is seen at b on Sept. 4. One cell t had died. The others, with the exception of the cell u, had undergone a successive cell division. In all the cells there were chloroplasts without any clearly visible pyrenoid. The division of a cell started by a bipartition of the nucleus and each of the chloroplasts, after which a cellulose partition-wall was formed between the two protoplasts before the following cell division started. The partition previously formed could not be bent in different planes by the subsequent partition-walls and thus influence the form of the cells, which was hence determined by the position assumed by the partition-wall at the cell division and by the subsequent development of the cellular tissue. In this respect Pleurococcus differed considerably from the algae treated above under the name of *Protococcus*. In the latter, cellulose cell-walls were not formed until after the completion of the division into 4, 8 or 16 protoplasts. The form of the cells was determined by the form assumed by the protoplasts before being provided with cellulose membranes. If they had not assumed an elongate form, the position of the protoplasts in relation to each other was that seen in fig. 2, where cell-tissues with formation of individuals out of the cells are demonstrated. The relative positions

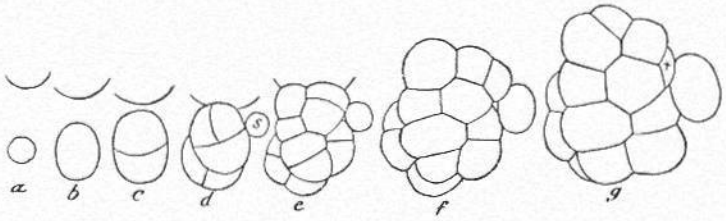

Fig. 9.

of the cells are quite different in *Pleurococcus*, which is seen in fig. 8 and 9 with formation of individuals out of the cells.

At b in fig. 8, the cell u had ceased its division but continued its growth, and for this reason it became larger than the other cells. A protoplast division had commenced in the cell, continuing subsequently as often as was rendered possible by the presence of a sufficient amount of water. It was completed at c after 37 days, on October 11. At the beginning of the observations of this day, at 1.20 p.m., the protoplasts situated within the up-turned side of the cell u occupied the position in relation to each other demonstrated in the figure. The membrane of this cell was further observed to be developed for the emitting of the protoplasts as zoospores in the area seen to the left in the figure where the cell was most strongly curved outwards. The membrane was thinner here, and there was a thick layer of plasma on its inside. At 2 p.m. this cell assumed the form shown at d in the upper part of the figure. The protoplasts within the cell were emitted through an opening in the thin part of the membrane and were kept together by a plasma film formed from the thick plasma layer inside the membrane. The ball-shaped heap of protoplasts increased in size and was then opened, whereby the protoplasts were emitted as zoospores of the form shown at e. They did not, as the zoospores of *Pr. Xanthoriae*, seek refuge in cavities after having swarmed for a while, but remained in open places, where they continued their development.

In fig 9 the development of an individual formed out of a zoospore of this kind is demonstrated at a. The development took place on a peridermal film from the same part of a birch-trunk as that mentioned above. In order to illustrate the slow development in this place in free nature, the dates of the 7 stages of development shown in fig. 9 will be given. They were: a 20th Sept. 1896, b 30th Nov., c 30th May 1897, d 10th Sept., e 21st Oct., f 21st Jan. 1898 and g 21st April. After one year, the individual a formed in Sept. 1896 had developed into con-

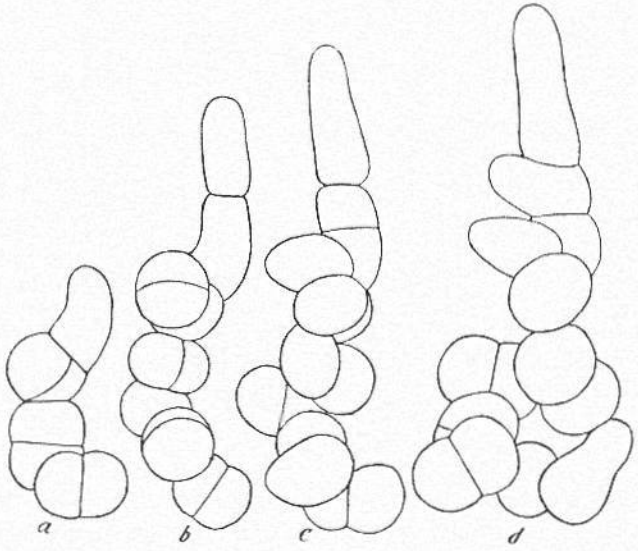

Fig. 10.

taining 5 cells. At the time before that when it was quadricellular, the cell situated on the top had grown somewhat faster than the others because of its freer position and had become bicellular earlier than the other three cells. The birch-trunk was dry when the peridermal film was taken for microscopic examination on the 10th of September 1897. Water was added shortly after it had been taken, at 12.35 in the day, and zoospores were observed shortly after 1 p.m. They increased in number and were quite numerous at 1.25 p.m. One of them stopped at s at 1.50 p.m. and attached itself to a place of free situation permitting unimpeded growth. After having attached itself to this place it grew more rounded at 1.53 p.m. and after that underwent a contraction that stopped at 2 p.m. Its subsequent stages of development are to be seen at e, f. and g. A continuation of these stages of development could not be obtained, as the algae in this place were overgrown by *Fumago* as a consequence of persistent humidity in the middle of the summer of the year 1898. The observations made revealed among other things that the multiplication of *Pleurococcus vulgaris* by zoospores took place above all in September.

It is seen already in fig. 8 at c and in fig. 9 at d that this alga multiplies also by separation of the cells. This fact is made apparent also by the varying development of the alga on the tree-trunk: no

cells were developed for formation of zoospores in places where it was more exposed to the influence of humidity. In such places the cells could often separate when only 4 of them were together. The alga here concerned was taken from such a place for cultivation on a peridermal film in a hot-house, where it was placed on a piece of old pine-bark and watered daily. Its development is demonstrated in fig. 10. A quadricellular individual was situated at a. After a few days, on Jan. 14, it had assumed the form seen at a in the figure. Three of the cells had separated and become bicellular, whereas the fourth cell, situated close to the substratum, presented apex growth. The following stages of development demonstrated in fig. 10 were observed at b on Jan. 25, at c on Feb. 2 and at d on Feb. 12. These illustrations show that the commenced apex growth continued, whereas for the rest the development remained much the same as in the original place of growth. In free nature in places with a high degree of humidity this alga produces, by apex growth, long rows of cells that are gradually separated from each other. An instance of the ramification of cell-rows with apex growth it also to be seen at d in the upper part of fig. 10.

The alga described and depicted by A. ARTARI under the name of *Pleurococcus simplex* in 1892 (Unters. ü. Entw. u. Syst. einiger Protococcoideen) is closely related to *Pleurococcus vulgaris*. It has a clearly conspicuous pyrenoid, as is also the case in *Protococcus Xanthoriae*, *Pr. Cladoniae*, *Pr. muscorum* and *Cystococcus humicola*, which have been mentioned above. The strongly conspicuous pyrenoid characteristic of all these species causes individuals having the same external form easily to be confused with each other. *Cystococcus humicola* differs considerably from other algae of a similar kind by its way of forming spores by successive cell division, a partition-wall of cellulose being formed after each protoplast division. This alga could therefore not emit zoospores. As has been stated already, the cells emitted as spores assumed varying forms. The form of the spores emitted consequently varied, and it determined the form assumed by the offspring of the alga in its multiplication by spores. This alga was the only one of the aerophile algae subjected to the investigations that formed spores in this way. In other species that emitted aplanospores, these were not provided with cellulose membranes until after the completion of the protoplast division.

As to the protoplast division, which takes place before the cell division in *Cystococcus humicola* and its modification forms *Hormidium parietinum* and *Prasiola crispa*, it should be added that it was com-

menced by division of the nucleus of the cell and completed by division of the pyrenoid by a plasmatic film dividing it into two parts from the outside and formed at the division of the nucleus. After this division of the protoplast, a cellulose partition-wall was formed in the plasmatic film formed at the division of the nucleus.

The results of continuous observations here published concern only a part of the aerophile chlorophyceae and are not sufficient as a basis of a systematic treatment of these organisms. The investigations could not be continued, however, because they were interrupted by other investigations of a more urgent nature.

Summary.

It has been proved necessary to make continuous observations of one and the same individual in order to obtain reliable knowledge of the cell division, multiplication and modifications of aerophile *Chlorophyceae*. A continuous observation method of this kind was made possible by cautious drying of algae sparsely distributed on an object glass or a transparent peridermal film. The algae attached themselves so firmly to the substratum that they were not torn away by a squirt of water or nourishment solution. Every algal individual examined thus remained firmly in its place and was not mixed with other individuals formed by the multiplication of the algae, as the latter had not been attached to the substratum by drying and were easily washed off after each microscopic examination. A common investigation method consists in comparing different stages of development of different individuals in a pure cultivation, but this method did not produce satisfactory results in investigations of the aerophile green algae. It was therefore necessary to elaborate a continuous observation method in order to obtain reliable knowledge of their development. But pure cultivation of the alga forming the object of the investigation was advantageous also when this method was employed. It is generally easily obtained by pure cultivation of lichenous algae. If different algal species were at hand in the same cultivation, the investigation method employed also had the advantage of rendering a comparison between different species possible with a view to their development and rate of growth under the same external conditions. Still another advantage is to be had in employing this investigation method. Also the development of algae growing on the periderm of a birch in free nature could be followed for a period of almost 2 years, as is shown by the results published in fig. 9.

Anmärkningsvärda fynd av hymenomyceter i Bohuslän, Västergötland och Dalsland.

Av T. Nathorst-Windahl.

År 1945 utarbetade jag en förteckning över anmärkningsvärda fynd av hymenomyceter i Bohuslän och Västergötland, och samma år publicerades denna i Meddelanden från Göteborgs Botaniska Trädgård. Under de sedan dess gångna åren har jag gjort talrika exkursioner, vilka under hösten 1946 även utsträckte sig till Dals Rostock och Håverud i Dalsland. Dessutom har jag ytterligare bestämt ett rätt stort antal tidigare insamlade svampar, som jag först ingående beskrev efter det färska materialet och sedan torkade. Flera av dessa svampar har visat sig vara av större intresse och de sammanföras i följande förteckning. Numren i texten hänvisa till min egen samling.

Vännen, Fil. Dr. Seth Lundell, Uppsala, har hjälpt mig att bestämma trenne arter, amanuensen John Eriksson, Uppsala, har granskat och bestämt olika kollekter tillhörande *Coloratae*-sektionen inom släktet *Peniophora* och Dr. Albert Pilát, Praha, beskriver en ny *Poria*-art. Av mina vänner här har tandläkare Lennart Åkerblom vid flera tillfällen sänt mig intressanta svampar, folkskollärare F. Karlvall har medföljt på många exkursioner och därmed varit mig till stor hjälp. Slutligen har folkskolläraren S. Woldmar, Uddevalla, dels sänt mig svampar, dels lämnat värdefulla lokaluppgifter. Till alla ett hjärtligt tack.

I artförteckningen användes följande förkortningar: Boh.=Bohuslän; Dals.=Dalsland; Gbg=Göteborg stads område; Naturp.=Göteborgs botaniska trädgårds naturpark; sn=socken; Vg.=Västergötland.

Artförteckning.

Lepiota laevigata Lange. — Boh. Marstrand. Koön på gammal körväg invid lövskog. 1. IX. 45; leg. L. Åkerblom. Sporer brett spolformade, 11—14×4.5 µ.

Armillaria imperialis Fr. — Dals. Skålleruds sn, Håverud strax ö. om sjön Åklången på torr mark i barrskog, 8. IX. 46; n. 4348.

Foten på denna förnäma och egenartade svamp, som Fries kallar »Fungus nobilissimus», står djupt nedsänkt i barrmattan och är försedd med tvenne ringar. Lamellerna äro långt nedlöpande som hos en *Clitocybe*. Enligt Ingelström ofta sedd i stockholmstrakten. Fries' bild i Icones är rätt dålig, hos Michael-Schulz, pl. 136, är den däremot god.

Collybia ambusta Fr. non Ricken. Fr. Icon. tab. 70: 2. — Boh. Rödbo sn, Ellesbo på gammal brandplats, 11. IX. 37. — Vg. St. Lundby sn, Gråbo på brandplats i skogsbryn, 19. IX. 37; n. 830. Sporer runda med grynigt innehåll, 4,5—5×4—5 µ.

Troligen är denna svamp inte sällsynt i vårt land, men eftersom den saknas i våra svenska svampfloror är den kanske värd att här omnämnas. I Värmland har H. Svensson funnit den på tvenne lokaler.

Mycena amicta Fr. Syn. *M. iris* Berk. Lange pl. 50 C. — Dals. Skålleruds sn, Håverud på barrträdsstubbe, 8. IX. 46; n. 4349.

M. fagetorum Fr. Lange pl. 56 E. — Boh. Jörlanda sn, Ranebo lund på boklöv, 30. IX. 45; n. 4207.

Denna art tyckes föredraga bokskogar, och då den hittills påträffats en enda gång inom området är den troligen sällsynt här. O. Rob. Fries omnämner den inte i sina publikationer över göteborgstraktens hymenomyceter.

M. rubromarginata Fr. sensu Ricken. Syn. *M. plicosa* Fr. var. *marginata* Lange, *M. capillaripes* Peck sensu Kühner.

I Monogr. Hym. Sueciae skriver Fries: »Est inter vulgatissimas Mycenas ad ligna mucida, ramos, strobilos in silvis variis subhumidis, ut pinetis, alnetis, etc.» Inom området har jag funnit den trenne gånger på multnande grangrenar, kottar etc. i fuktig, mossig barrskog samt dessutom sett den växa på en fallen hasselgren i Naturp. H. Svensson anser den vara »ganska sällsynt» i Värmland. Under exkursioner i sex olika socknar i sistnämnda landskap hösten 1947 fann jag inte ett enda exemplar av denna art. Eftersom både Ingelström och Krok & Almquist anse att denna art är tämligen allmän i vårt land har den förmodligen en östlig utbredning. Fries' bild i Icones tab. 78: 4 är alldeles för blek, men Langes bild — *M. plicosa* v. *marginata* — är utmärkt.

M. uracea Pearson — Gbg, Naturp. på gammal brandplats på förkolnade ljungrötter och oftast fäst vid dem 2—3 cm under markytan, 1. X. 37; n. 871. Sporer brett ovala, 8—10(—11)×6,5—7 µ, cystider 20—35×13—15 µ med korta bihang.

Hattens mörka färg påminner mycket om den hos *M. galopoda* v. *leucogala*. Enligt Pearson växer den även i England »in terra ambusta ad radices ericetorum». I Friesia, B. III H. 3 sid. 203 uppger Morten Lange, att han i Danmark sett den växa på ett icke avbränt område på rötter av *Vaccinium uliginosum* och på gamla bladslidor av *Monilia coerulea*.

Omphalia picta Fr. — Under de senaste åren sedd här och var på fallna, murkna alstammar i Gbg, Naturp.

O. Postii Fr. Bres. tab. 262: 1. — Gbg, Botaniska trädgården på fuktig mark invid en damm, 18. VII. 48.

O. speirea Fr. Lange pl. 61. C och E. — Denna lilla, gracila art före-

kommer i skuggiga, fuktiga raviner och växer på småpinnar, barkbitar o.s.v. och är långt ifrån sällsynt inom området.

Volvaria plumulosa (LASCH) QUÉL. LANGE pl. 68 A. — Vg. Backa sn på gammal avstjälpningsplats strax s. om Brunnsbo, 23. VII. 42 och sedan nästan årligen påträffad, särskilt efter kraftiga regnskurar i augusti. Sporer 6,5—7,5(—8)×4,5—5 µ, cystider mest brett spolformade, 9—17 µ breda; n. 3088.

Pluteus Robertii FR. LANGE pl. 71 A. — Gbg, Rya skog på murken gren liggande på marken, 8. VIII. 45; n. 4063.

Entoloma ardosiacum FR. LANGE pl. 74 A. — Vg. Råda sn strax n. om Rådasjön i mossa under granar, 7. VIII. 37; n. 686. — Vg. Partille sn, Partille c:a 300 m ssv. om »Paradiset» under gran och hassel, 27. VIII. 45.

E. radiatum LANGE. — Gbg, Naturp. på öppen, mossig mark bland ljung på bergsluttning, 22. VIII. 45; n. 4078.

Claudopus byssisedus (PERS.) QUÉL. LANGE pl. 80. C. — Gbg, Naturp. på undersidan av en på marken liggande, murken alstam, 20. VIII. 46; n. 4318.

Cortinarius balteatus FR. FRIES Icon. pl. 142: 2. — Gbg, Slottsskogen i gräs under lövträd, 15. VIII. 39; n. 1554. Sedd även senare år på ungefär samma plats. — Boh. Marstrand, Backudden i gräsplan intill lövträd, 15. IX. 41.

C. croceo-coeruleus (PERS.) FR. sensu LANGE. — Vg. Lerums sn strax sö. om Lilla Stamsjön i granskog, 20. IX. 45; n. 4174.

C. emollitus FR. LANGE pl. 86 B., RICKEN pl. 44. 1. — Gbg, Slottsskogen på torr, hård jord under bokar, 15. IX. 43; n. 3681.

Denna spindelskivling växer mest tuvad. Detta omnämnes inte av LANGE och RICKEN, men i Monogr. Hymenom. Suecici delar FRIES upp arten i tvenne former, A och B. I samband med den förra skriver han: »Saepius caespitosus, sed etiam solitarius». Enligt LANGE växer den även i Danmark på torr, hård mark i bokskog.

C. holophaeus LANGE. — Gbg, Naturp. i lövskog, 18. IX. 41; n. 2802.

C. olivascens FR. LANGE pl. 86 A. — Vg. Alingsås på gräsplan under lövträd invid järnvägsstationen, 25. VIII. 46; n. 4331. Enligt LANGE skall *C. infractus* (PERS.) FR. vara större och dessutom ha vårtiga sporer, men för övrigt stå de båda arterna varandra mycket nära.

Pholiota aurivella (BATSCH) FR. — Vg. Alingsås, Nohlhaga på stammen av levande kastanj c:a 4 m högt över marken, 18. X. 45; n. 4282.

P. filaris LANGE. Syn. *P. togularis* (BULL.) FR. var. *filaris* FR. — Gbg, Rya skog på bar mark under lövträd, 25. IX. 45; n. 4200.

P. pumila FR. sensu SEV. PETERSEN och F. H. MÖLLER. — Vg. Partille sn, Partille c:a 300 m v. om järnvägsstationen i mosstuvor på bergsluttning, 27. VIII. 45; n. 4089.

Sporer 9—10×6,5 µ, vårtiga. Cystider omkring 60×9 µ, överskjutande basidierna högst 10 µ, trådlika, utvidgade i toppen och här 3—4 µ tjocka.

Hebeloma longicaudum (PERS. ex FR.) QUÉL. — Vg. Skallsjö sn, Floda på vägkant i blandskog, 24. IX. 37; n. 856.

H. spoliatum FR. LANGE pl. 120 A. — Gbg, Naturp. på gammal brandplats, 7. X. 40; n. 2322. — Vg. Härryda sn strax ö. om Rya hållplats i barrskog, 20. X. 40; n. 2365.

En mycket karakteristisk art med foten förlängd 3—8 cm i marken.

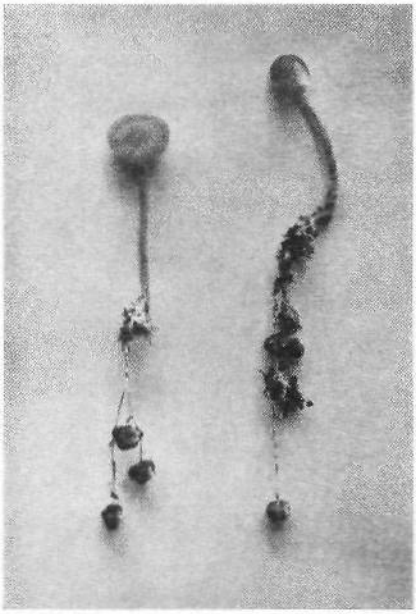

Fig. 1. *Naucoria arvalis* Fr. De långsamt avsmalnande rotlika förgreningarna förbinda foten med tre till fem mörka, nästan runda, 10—15 mm stora sklerotier. Med myceliesträngar ge några av dem åter upphov till nya sklerotier. — *Naucoria arvalis* Fr. The gradually tapering pseudorhizas connect the stipe with three to five dark colored subglobose 10—15 mm large sclerotia. From mycelial fibres some of them produce new sclerotia again.

Bilden i FRIES' Icones, pl. 113: 2. visar ej den i texten omnämnda, förlängda foten.

H. strophosum FR. — Vg. Lerums sn c:a 100 m nv. om Stamsjövik under björk och gran vid vägkant, 2. X. 40; n. 2299.

Naucoria arvalis FR. Syn. *N. arvalis* FR. var. *tuberigena* QUÉL., *N. temulenta* FR. sensu RICKEN. — Gbg, Slottsskogen i glest gräs under höga lövträd, 30. VIII. 45. — Gbg, Botan. trädgården i mattor av *Sedum* och *Thymus*, 31. VIII. 45; n. 4103. — Boh. Marstrand, Koön, Långedal i lövskog, 2. IX. 45. — Gbg, Backa på gammal avstjälpningsplats strax s. om Brunnsbo, 9. IX. 48; n. 5013.

»It remains to be seen whether any real difference exists between the sclerotiabearing form and the ordinary type. The mycelioid root in the latter may indicate, that it springs from a sclerotium» skriver LANGE i Flora Agaricina Danica. Enligt min mening kan det knappast råda något tvivel om att de exemplar som saknat sklerotier vid upptagningen ur marken inte kommit upp hela. De svarta sklerotierna, som oftast ligga omkring 10 cm djupt, bli ofta över 1 cm i diameter och fotens rotliknande förlängning är hårfin och ytterst skör. Vid en omsorgsfull upptagning av ett rätt stort antal svampar visade det sig att sklerotiernas antal växlade mellan ett och fem under varje svamp samt att några av dem sände ut myceliesträngar, som i sin tur utbildade nya. På individet till höger på bilden ses tvenne nybildade sklerotier.

N. reducta FR. LANGE pl. 124 D. — Gbg, Rya skog på fuktigt liggande lövträdsstammar och pinnar, 11. VI. 48; n. 4945.

Hatt i centrum brunaktigt olivfärgad, mot kanten ljust olivfärgad. Lameller, särskilt på unga exemplar, ovanligt bleka för att tillhöra en art inom detta släkte.

N. subsphaerospora JOSSERAND. — Gbg, Naturp. i murken, ihålig lövträdsstubbe, 12. IX. 45; n. 4144.

Nyligen beskriven i Bull. trim. de la Société Mycologique de France, Band. LXIV sid. 21.

Hatt omkring 1 cm i diameter, brungul, torr och matt på ytan, först kullrig, sedan mer eller mindre platt. Fot mer eller mindre horisontellt framväxande, men hastigt uppåtböjd något nedanför hatten och med ungefär samma färg som denna. Lameller tämligen täta, vidfästa och något gulare än hatten. Sporer 4,5—5,5×5—5,5 µ, småvårtiga. Cystider smala, men något vidgade mot basen, 30—40 µ långa och i toppen med ett nästan klotformigt huvud som är c:a 4 µ i diameter.

Tubaria anthracophila KARST. — Gbg, Slottsskogen på multnande trädelar och sågspån på vedbacke där den regelbundet återkommer år efter år.

Denna art kommer närmast *T. furfuracea* (PERS.) FR., men är tuvbildande och har rätt stora, koncentriskt, ordnade, vita flockulliga lämningar i hattkanten efter hyllet. Sporer 6—6,5×4—5 µ. Cystider 30—45×10—15 µ och således mycket avvikande från dem som förekommer hos *T. furfuracea*.

T. crobula FR. LANGE pl. 127 D. — Gbg, Slottsskogen på en gammal säck under en gran, 30. VIII. 41; n. 2625.

Galera aberrans KÜHNER. — Vg. Backa sn på gammal avstjälpningsplats strax s. om Brunnsbo, 8. X. 45; n. 4246.

G. cyanopoda ATK. sensu KÜHNER. — Vg. Backa sn på förut nämnda avstjälpningsplats, 23. VII. 42; n. 3083. Den ljusa, mot basen mer eller mindre grönblåaktiga foten är synnerligen karakteristisk för arten.

G. graminea VELEN. sensu KÜHNER. — Även denna art är funnen på förut nämnda avstjälpningsplats, där under årens lopp så många intressanta och sällsynta svampar insamlats. Nästan årligen ses den här, men uppträder mest sent på hösten; n. 3901. — Vg. Gärdhems sn, Lundens gård på äng i magert gräs, 13. IX. 44.

Pluteolus aleuriatus FR. — I Naturp. ses den nästan årligen på fallna, oftast avbarkade grenar, men endast i enstaka exemplar.

Crepidotus autochthonus LANGE. — Vg. Västra Frölunda sn, Johannelund på bar mark under ekar i bergig terräng, 11. IX. 43; n. 3659.

C. Lundellii PILÁT. — Gbg, Naturp. på undersidan av på marken liggande almgrenar efter kraftigt regn, 24. VII. 41; n. 2489.

Beskriven i LUNDELL & NANNFELDT, Fungi Exsicc. Suecici nr 220. Här uppger LUNDELL, att den är tämligen allmän omkring Uppsala och att den där förekommer mest på alm.

Psalliota haemorrhoidaria (SCHULZ.) FR. LANGE pl. 137 C., KONRAD & MAUBLANC pl. 28. — Gbg, Sankt Pauli kyrka i gräsplan under lövträd, 4. VIII. 45; n. 4059.

Hatt till 15 cm i diameter med breda, rödbruna, tilltryckta, fibrösa fjäll. Fot till 2.5 cm tjock, vitaktig, med rätt kraftig basalknöl och starkt rodnande vid tryck. Sporer 7—8×4,5—5 µ, cystider ballongformade, 13—22 µ breda.

P. subrufescens PECK sensu LANGE. — Gbg, Slottsskogen på naken jord mellan buskar under höga lövträd, 18. VII. 48: n. 4971.

Hatt med tilltryckta, gulbruna—mörkbruna fjäll på vit botten. Lameller kötträda, ring mycket bred och tunn. Sporer 7,5—8×5,5 µ.

Stropharia squamosa (PERS.) FR. — Vg. Alingsås mellan Nohlhaga och sjön Mjörn på hopade pinnar och löv på skuggigt ställe, 21. IX. 41. — Även sedd i nordligaste Halland, Lindome sn, Hällesåker i en ravin på pinnar bland diverse örter, 16. X. 45; n. 4277.

De flesta svampfloror uppge, att denna art skall växa i bokskogar, men på de båda ovan angivna lokalerna fanns det inga bokar i närheten av fyndplatsen.

Hypholoma radicosum LANGE. Syn. *H. epixanthum* RICKEN, non FR. — Boh. Marstrand, Koön på murken, nästan i marken dold barrträdsstubbe, 2. IX. 45; n. 4106.

Psilocybe dichroa KARST. LANGE pl. 149 B. — Gbg, Slottsskogen på gamla multnande *Scirpus*-blad på ur ett dike uppkastat, uttorkat bottenslam, 19. VII. 40; n. 1992. Sporer 8—9,5(—10)×5 µ, cystider 25—30×3—5 µ.

P. papyracea (BOLT.) FR. LANGE pl. 147 B. — Gbg, Kärralund på avverkad, rätt murken poppelstam liggande på marken i högt gräs, 19. X. 43; n. 3758. Sporer 7—8×4—4,5 µ, cystider 40—45×9—10 µ.

P. sarcocephala FR. sensu KONR. & MAUBL. pl. 45. — Boh. Marstrand, Koön, Rosenlund i en kraftig tuva intill basen av en lövträdsstam, 24. IX. 48; n. 5055.

Sporer 8—9×5—5,5 µ, mest med oljedroppe. Cystider 30—40×13—18 µ, brett buteljformade och i topparna försedda med kristallkorn.

Psathyra fibrillosa (PERS.) FR. LANGE pl. 152 D. — Gbg, Kålltorp i blandskog, 29. IX. 45; n. 4205.

P. obtusata (PERS.) FR. — Gbg, Rya skog på fuktig liggande eller delvis i marken dolda pinnar under al och hassel, 2. X. 47; n. 4810.

Sporer mest något bönformade, 8—9×4,5—5 µ, cystider på lamellsidorna (pleurocystider) ballongformade, 25—30×18—20 µ, cystider på lamelleggen (cheilocystider) buteljformade, 30—40×12—13 µ.

P. squamifera KARST. sensu LANGE pl. 154 A. — Gbg, Naturp. vid väg bland *Geum urbanum* och *Filipendula ulmaria*, 4. X. 47; n. 4407. — Står nära *P. gracilis* FR., men hattkanten är i början försedd med vita, silkesaktiga fibrer. Sporer 11—12(—13)×6,5 µ, cystider tillspetsade mot toppen, 45×9 µ.

P. typhae (KALCHB.) FR. — Gbg, Botan. trädgården i vattenkar på döda strån av *Carex riparia* och fäst omedelbart ovan vattenytan. 13. VII. 48; n. 4965.

Coprinus angulatus PECK. LANGE pl. 157 D. — Gbg, Stora Torp på hästspillning, multnande löv etc. i skuggan under höga lövträd, 27. VII. 40; n. 2008.

C. bisporus LANGE. F. H. MÖLLER fig. 69. — Gbg, Botan. trädgården på hästspillning i hög, 30. VI. 46; n. 4313.

Starkt tuvad. Hatt till 1,2 cm i diameter, fot till 6 cm lång och nedtill utgående från i spillningen dolda myceliesträngar, vilka dock inte voro så kraftigt utbildade som MÖLLERS bild visar. Basidier 18—22×6—7 µ, sporer med (1)—2 sterigmer, 10—13×6,5—7,5 µ, cystider brett ovala, 30—35×20—28 µ.

Hygrophorus leucophaeus Fr? sensu Ricken. Lange pl. 163 G. — Gbg, Slottsskogen i magert gräs under bokar, 15. IX. 43; n. 3678.

H. subradiatus Fr. — Gbg, Rya skog på fuktig äng vid skogsbryn, 8. VIII. 37; n. 691. — Boh. Marstrand, Koön på äng vid skogsbryn, 24. IX. 48; n. 5056.

Lactarius chrysorrheus Fr. Knauth & Neuhoff, Die Pilze Mitteleuropas, Bd. 11 b. — Boh. Marstrand, Koön i lövskog under ekar, 24. IX. 48. — Boh. Kareby sn, Kareby c:a 100 m nv. om Myrbacka gård under hassel och ek, 28. IX. 48. — Boh. Hålta sn strax sv. om Hålta kyrka under unga ekar i lövskog, 30. IX. 48; n. 5070.

L. hysginus Fr. Michael-Schulz pl. 212. — Boh. Hålta sn c:a 200 m nö. om Hålta kyrka i barrskog, 30. IX. 48; n. 5071.

Denna sällsynta riska, som lätt kan förväxlas med *L. trivialis* Fr., har rödbrun, starkt klibbig och oftast rynkad, svagt zonerad hatt. Foten är kort och klibbig, som äldre ihålig. Lameller blekt gulaktiga.

L. lilacinus (Lasch) Fr. Knauth & Neuhoff, Die Pilze Mitteleuropas, Bd. 2. — Gbg, Rya skog under *Alnus, Rhamnus, Fraxinus* etc., 25. IX. 45; n. 4199. Då och då även iakttagen under senare år.

L. lilacinus (Lasch) Fr., som växer under al, och *L. spinosulus* Quél., som följer björken, komma varandra mycket nära. Den senare har mot hattkanten upprättstående, spetsiga hårfjäll, som den förra saknar. Langes och Ingelströms *L. lilacinus* är *L. spinosulus*.

Russula atropurpurea Krombh. Lange pl. 182 D. — Gbg, Kärralund under ekar på fuktig mark, 26. VIII. 45; n. 4086.

Den rödvioletta, i mitten ofta mycket mörka hatten och den efter hand grånande foten ger den en viss likhet med den i barrskogarna förekommande *R. obscura* Rom.

R. depallens Fr. Konrad & Maublanc pl. 354. Syn. *R. exalbicans* Secr. — Gbg, Slottsskogen under björkar i gammal gräsplan, 8. IX. 48; n. 5010.

R. pseudointegra A. & G. Lange pl. 193 D. — Omkring Göteborg är denna art, som mycket liknar *R. lepida* Fr., icke sällsynt under ekar. Hatt lysande cinnoberröd, lameller slutligen ljust ockergula, fot vit.

R. versicolor J. Schff. Lange pl. 194 B. — Gbg, Slottsskogen under björk i gräs, 4. VII. 48; 4957.

R. violacea Quél. Konrad & Maublanc pl. 350. — Gbg, Slottsskogen under lövträd i gammal gräsplan, 18. VII. 48; n. 4970.

Lentinus suavissimus Fr. — I våra svenska svampfloror betecknas denna behagligt doftande svamp som sällsynt. Under de senaste åren är den påträffad på flera ställen inom området och i brev anser S. Woldmar att »den tydligen inte är så sällsynt» i uddevallatrakten. Den brukar nästan alltid uppträda samtidigt och tillsamman med *Naucoria erinacea* Fr. Mest finner man dessa båda arter på torra grenar av *Salix cinerea* och dennas hybrider med *aurita*.

Panus ringens Fr. — Gbg, Naturp. på fallen björkgren, 29. III. 47; n. 4372.

Boletus appendiculatus Schaeff. Kallenbach, Die Pilze Mitteleuropas, pl. 31. — Boh. Kareby sn, Kareby c:a 150 m nv. om Myrbacka gård på gräsbevuxen mark under gamla ekar, 28. IX. 48; n. 5062.

Här först funnen av aktuarie Lars Asplund, men då de för bestämning

inlämnade exemplaren voro mer eller mindre ofullständiga, gjordes ett besök på växtplatsen, varvid tvenne exemplar insamlades.

B. carpini (R. SCHULZ) PEARSON. — Gbg, Naturp. i lövskog, mest hassel, 11. VIII. 44; n. 3846. Återsedd på samma lokal, 17. VIII. 45.

Rätt lik strävsoppen, men skiljer sig tydligt från denna och måste anses vara en god art. Hatt brun med dragning åt oliv, ojämnt rynkad och ofta sprucken. Hatthudens celler mer eller mindre runda. Det nästan vita köttet blir i luften först rödaktigt, sedan grått till nästan svart. Hos strävsoppen är hattytan slät, hatthuden består av utdragna celler, och köttet blir i luften så gott som oförändrat.

Polyporus Wynnei B. & B. — Gbg, Naturp. i östra kanten av Finsmossen på löv och vissna grässtrån liggande på markytan under högt gräs, 9. XI. 42; n. 3491.

Enligt Svensk Botanisk Tidskrift, 1936, Bd. 30 har LUNDELL förut funnit den trenne gånger invid Uppsala. Den anses dock vara mycket sällsynt och förut känd från några få lokaler i England, Holland och Tyskland.

Poria Nathorst-Windahlii PILÁT sp. n. — Gbg, Naturp. på undersidan av multnande trädelar av lövträd vid uttorkad bäck i djup skugga, 29. VI. 1947; n. 4378.

Denna *Poria* passade inte in på någon av de arter, som finnas beskrivna i »Atlas des Champignons de l'Europe, Polyporaceae» av ALBERT PILÁT. Den hade något större sporer än *P. dentipora* BRES., porväggarna voro inte utdragna till spetsiga tänder som hos denna art och färgen, även hos intorkat material, var betydligt ljusare. Dr. PILÁT, Praha, som sett torkat material, anser att den kommer närmast *P. reticulata* Pers., men med mindre sporer och porer än denna och icke rent vit färg. Han har haft vänligheten bifoga följande latinska diagnos:

Resupinata, tenuis, exsiccata sordide albida, sordide griseola vel subisabellina, inseparabilis, gossypino-mollis fragilisque, tenuiter fragiliterque membranacea, margine similis vel indistincta, haud byssoidea, rarius paulisper gossypino-membranacea.

T u b u l i breves, solum 0.2—1 mm longi, sordide albidi, plerumque subobliqui.

P o r i humiles, angulati, plerumque subapert vel obliqui, sed etiam regulares, 0.13—0.3 mm diam., dissepimentis tenuibus, 30—40 u crassis instructi, apice irregulares, sed haud denticulati.

T r a m a basalis subnulla, ex hyphis paucis plerumque subverticaliter laxe intricatis, ad septa subcontractis, tenuiter tunicatis, hyalinis, 6—9 u crassis. Hyphae mediostrati tubolorum conferte verticaliter intricatae, subisabellinae, septatae, 3—6 u crassae.

S p o r a e breviter cylindraceo-curvulae, subreniformes, apiculo obliquo, parvo, fere laterali destitutae, biguttulatae, hyalinae, laeves,

4—5,5×1,3—2 μ. Hab. ad ligna valde putrida udaque arboris frondosae alicuius. Suecia: Vestrogothia: Göteborg: Naturparken, 29.—VI.—1947. cel. T. Nathorst-Windahl legit.

Species nostra nova *Poriae reticulatae* Pers. affinis videtur, sed forma sporarum, poris minoribus et colore sordido discrepat. Color ligni putridi fere albus et eius consistentia mollis fragilisque est. Typus in herbario Musei Nationalis Pragae et in herbario Horti Botanici Gotoburgensis.

Efter torkningen förändrades färgen knappast och även i färskt skick hade svampen en orent vit till ljust gråaktig färg (sordide albida) och lossnade ej från substratet (inseparabilis).

P. Vaillantii (DC.) Sacc. — Funnen flera gånger i Vg. Backa sn strax s. om Brunnsbo där den ofta ses växa på basen av vissna grässtrån, på undersidan av på marken liggande bark- och tjärpappsbitar o.s.v. Kanten är oftast försedd med vita, förgrenade myceliesträngar. Cystider 0. Sporer elliptiska, snett tillspetsade mot basen, 4,5—6(—7)×2,5—4,5(—5) μ; n. 3606.

Merulius fusisporus Romell. (det. S. Lundell) — Hittills mest påträffad i Vg. i bottenlagret av c:a 1 år gamla, fuktigt liggande högar av avverkade grangrenar, där barren ännu satt kvar och möjligen skyddade mot uttorkning; n. 2395 och 3751. Även funnen inuti hopade högar av ljung, furukvistar och barr i barrskog; n. 2340. — I Boh. Forshälla sn, Grohed funnen bland hopade barrträdspinnar i skog, 28. IX. 41; n. 3751. Svampen brukar oftast ha en om vanilj påminnande doft. Se för övrigt Lundell & Nannfeldt Fungi Exsicc. Suecici nr 1334.

M. pinastri (Fr.) Bur. — Rätt vanlig på gamla avstjälpningsplatser invid Göteborg. Där växer den mest på i markytan liggande trä- eller pappbitar, gamla skor o.s.v. Bäst utvecklad sent på hösten.

Svamp ofta utbredd till 10 à 15 cm, gulröd till olivgul, mjuk och lätt att lossa från underlaget. Kant fibröst vitluden. I början är hymeniet rynkat och bildar mer eller mindre regelbundna porer, vilkas väggar efter hand växa ut till spetsiga, något snett stående, mot basen flata taggar. Basala hyfer 4—5 μ, här och var utvidgade, 6—9 μ. Sporer nästan ovala, 5—6×3,5—4,5 μ, gula.

Hydnum amicum Quél. — Boh. Marstrand, Koön, Rosenlund under höga bokar invid berghäll, 15. IX. 41; n. 2767. Även sedd senare på samma plats, t.ex. hösten 1948.

Hatt i början filtad, ljust violettgrå, men efterhand kal i centrum och där brunaktig. Taggar först silvervita, sedan gråaktiga. Doft utpräglad, söt.

H. melaleucum Fr. Syn. *H. graveolens* Del. — Boh. Hålta sn c:a 150 m nö. om Hålta kyrka i barrskog, 30. IX. 48; n. 5075.

Sistotrema muscicola (Pers.) Lundell n. comb. — Vg. Kållereds sn strax ö. om Stretered på hopade småkvistar av ljung, barr etc., 12. X. 40; n. 2335. — Gbg, Naturp. under björkar på multnande småpinnar, löv etc. under nyfallna löv; 21. X. 41; n. 2916. — Gbg, vid Finsmossens västra kant under björkar på multnande småpinnar och löv, även här täckta av de nyfallna löven, 9. XI. 42; n. 3493, 3494.

Under namnen *Sistotrema sublamellosum* (Bull.) Quél. subsp. *erice-*

torum B. & G. och *Poria albo-pallescens* B. & G. sändes denna svamp till LUNDELL. En del exemplar hade trubbigt syllika taggar och utbildade sparsamt smärre hattar, vilka dock inte voro fästa i marken utan med hattytan fästa i överliggande löv och med foten hängande fritt mot marken. Många detaljer stämde bra efter beskrivningen på denna *Sistotrema* i Hymenomycètes de France av BOURDOT & GALZIN. Andra exemplar sågo däremot ut som en *Poria* och stämde väl med beskrivningen av *Poria albo-pallescens* B. & G.

LUNDELL har jämfört det sända materialet med *Grandinia muscicola* (PERS.) BRES. ur BOURDOT's herbarium och i LUNDELL & NANNFELDT Fung. Exsicc. Suecici nr 1415a meddelar han, att det sända materialet till alla delar överensstämmer med denna svamp, men att den på grund av de urnelika basidierna bör hänföras till släktet *Sistotrema*.

Vid insamlingen av denna egendomliga svamp observerade jag, att på de ställen, där bladen lågo tätt intill varandra, växte svampen som en *Poria*, på andra ställen med större utrymmen, där kanske fuktigheten var mindre, t.ex. på undersidan av löst eller fritt liggande småpinnar, utbildades de syllika taggarna.

Solenia poriaeformis FR. Syn. *S. urceolata* (WALLR.) FR. — Gbg, Rya skog på undersidan av på marken liggande askstam, 25. IX. 45.

Cyphella capula (HOLMSKJ.) FR. — Vg. Lerums sn strax nö. om Bävsjön på potatisblast i hög vid åker, 4. VII. 47; n. 4380.

Cotylidia vitellina (PLOWR.) LUNDELL n. com. Syn. *Thelephora vitellina* PLOWR. —

Den i Meddel. från Göteborgs Botan. Trädgård Bd 16 sid. 154 omnämnda *Sistotrema vitellina* (PLOWR.) LUNDELL stämde till alla delar med material, som insamlades i Femsjö, Småland och som utdelades som nr 1021 i LUNDELL & NANNFELDT, Fungi Exsicc. Suecici. På ändrad etikett meddelar emellertid LUNDELL, att han, sannolikt på grund av ett missöde, oriktigt placerat denna svamp i släktet *Sistotrema*. Basidierna äro smalt klubbformade, inte urnelika.

Thelephora mollissima (PERS.) FR. — Gbg, strax s. om Slottsskogsvallen under bokar på löv, pinnar och naken jord, 11. IX. 48; n. 5022.

Tomentella fuscocinerea (PERS.) DONK (det. S. LUNDELL) — Vg. Medelplana sn, Kinnekulle, Råbäck på gammal väg i skuggig trädgård, 8. IX. 42; n. 3278.

T. subfusca (KARST.) v. H. & L. — Boh. Dragmarks sn, Bassholmen på undersidan av en på marken liggande, avbarkad, murken aspstam, 21. VIII. 48; n. 4990.

Svagt violettaktigt brun. Sporer 8—9×(7,5)—8 µ, elliptiska och med till 2 µ långa, fina taggar. Hyfer 6—8(—9) µ tjocka, ljusbruna, förgrenade i räta vinklar, här och var med mellanväggar och med söljor vid dessa.

T. verrucispora B. & G. — Vg. Fuxerna sn, Göta strax ö. om Haneströms säteri på stubbe i barrskog, 7. X. 45; n. 4228.

Liksom hos den här ej sällsynta *T. isabellina* FR. har denna art ett mer eller mindre gulaktigt hymenium, men hyferna äro endast 3—4 µ tjocka och de vårtiga sporerna påminner om dem man finner hos *Inocybe asterospora* QUÉL.

Peniophora aegerita (HOFFM.) v. H. & L. — Gbg, Naturp. på undersidan av i den delvis uttorkade bäcken liggande algrenar, 22. VIII. 46. Då och då även sedd i Gbg, Rya skog.

Arten växer sparsamt tillsamman med *Aegerita candida* PERS. Den senare är mycket allmän på undersidan av fuktigt liggande lövträdsgrenar på skuggiga ställen och bildar små, tätt och löst sittande grynliknande kroppar, konidiestadiet av *P. aegerita*.

P. longispora (PAT.) v. H. & L. — Gbg, Naturp. på undersidan av murkna träbitar av lövträd på skuggigt ställe vid bäck, 22. VIII. 46; n. 4327.

P. nuda (FR.) BRES. (det. J. Eriksson). — Vg. Mölndal, Gunnebo på undersidan av på marken liggande bokgren, 9. V. 37; n. 495. — Gbg, Slottsskogen på lindgren liggande i en buske, 2. XI. 38; n. 1368. — Gbg, Kärralund på undersidan av en på marken liggande syrengren, 16. X. 40; n. 2440.

P. ochroleuca (BRES.) v. H. & L. — Den i Meddel. från Göteborgs Bot. Trädgård Bd 16 sid. 159 omnämnda *P. fusispora* (SCHROET.) v. H. & L. kan, med hänsyn till den ingående utredning av ROGERS i Farlowia Bd 1 sid. 103, icke vara synonym med *Hypochnus fusisporus* SCHROET., som han anser vara synonym med *Pellicularia flavescens* (Bon.) ROGERS (*Corticium flavescens* (BON.) WINTER).

Corticium atrovirens (FR.) FR. — Vg. Fuxerna sn, Göta strax nö. om Haneströms säteri i murken barrträdsstubbe, 7. X. 45; n. 4241. — Gbg, Naturp. på undersidan av på marken liggande, multnande pinnar, fruktskålar av bok, löv etc., 5. XI. 45; n. 4284.

Tulasnella pruinosa B. & G. (det. S. LUNDELL) — Gbg, strax invid Särö-banans rangerbangård på undersidan av en uppbruten stubbe, 4. IV. 38; n. 1064.

Sebacina incrustans (PERS. ex FR.) TUL. — Gbg, Slottsskogen på gammal gräsplan under höga lövträd, 20. VIII. 45; n. 4074.

Ceratobasidium atratum (BRES.) ROGERS (det. D. ROGERS) — Gbg, Frölundaborg på basen av död i marken stående stam av *Thuja occidentalis*, 4. XI. 44; n. 4027. — Gbg, Naturp. på undersidan av en på marken liggande, murken gren av *Juniperus*, 14. XI. 45; n. 4287.

LUNDELL, som sett material av denna svamp, sände i sin tur detta till D. ROGERS i New York. I brev till LUNDELL skriver han bl.a.: »first material I have known from outside the western hemisphere».

Summary.

The author gives the localities for some interesting or rare Hymenomycetes to the provinces of Bohuslän, Västergötland and Dalsland in south-western Sweden. The paper is a supplement to NATHORST-WINDAHL, Acta Horti Gotoburgensis Tom. XVI p. 135. The following species are very rare or not earlier reported in Sweden: *Lepiota laevigata* LANGE, *Mycena uracea* PEARSON, *Volvaria plumulosa* (LASCH) QUÉL., *Pluteus Robertii* FR., *Pholiota pumila* FR. sensu SEV. PETERSEN samt F. H. MÖLLER, *Naucoria subsphaerospora* JOSS., *Tubaria anthracophila* KARST., *Galera aberrans* KÜHNER, *G. cyanopoda* ATK., *Crepidotus autochtonus* LANGE, *Psilocybe dichroa* KARST., *P. papyracea* (BOLT.) FR., *P. sarcocephala* FR. sensu KONR. & MAUBLANC, *Psathyra squamifera* KARST., *Coprinus angulatus* PECK, *C. bisporus* LANGE, *Lactarius hysginus* FR., *L. lilacinus* (LASCH) FR., *Polyporus Wynnei* B. & B., *Poria Nathorst-Windahlii* PILÁT, *Sistotrema muscicola* (PERS.) LUNDELL, *Tomentella fuscocinerea* (PERS.) DONK, *T. subfusca* (KARST.) v. H. & L., *T. verrucispora* B. & G., *Peniophora aegerita* (HOFFM.) v. H. & L., *Tulasnella pruinosa* B. & G., and *Ceratobasidium atratum* (BRES.) ROGERS.

The author has exsiccated and preserved the collected fungi for future examination in herbaria, so that doubt cannot arise later as to what species have been found.

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Litteratur.

Photosynthesis in Plants. A Monograph of The American Society of Plant Physiologists. Edited by J. Franck and W. E. Loomis. Ames, Iowa, 1949.

I väntan på andra delen av Rabinowitchs Photosynthesis har The American Society of Plant Physiologists utgett en monografi behandlande de nyaste landvinningarna på fotosyntesens område. Boken, som innehåller 22 mer eller mindre fristående uppsatser av olika författare, ger redan genom sin omfattning — 500 sidor — en föreställning om den intensiva forskning, som för närvarande bedrives på detta gebit. Det är betecknande, att flertalet uppsatser behandla fotosyntesens mekanism och att endast några få syssla med yttre faktorers inflytande på kolsyreassimilationen. Ofta få olika skolor med divergerande forskningsresultat komma till tals, och boken ger en god uppfattning om hur skilda åsikterna ännu äro även på fundamentala punkter, när det gäller den mest betydelsefulla av alla kemiska reaktioner. Samtidigt får man ett starkt intryck av att problemen under de senare åren bragts närmre sin lösning än under någon tidigare epok. Undersökningarna karakteriseras av ett intimt samarbete mellan växtfysiologer, kemister och fysiker.

Boken inledes med en översikt över de aktuella problemen av Loomis. En uppsats om fotosyntesen under fältförhållanden av Thomas och Hill är av intresse inte minst ur ekologisk synpunkt. Diffusionen genom perforerade membraner behandlas av Verduin. Sedan betydelsen av interferens mellan närgränsande klyvöppningar kunnat påvisas och en lag för densamma kunnat härledas och experimentellt bekräftas, kommer frågan om klyvöppningsviddens betydelse för gasutbytet delvis i en ny belysning, och en del tidigare motsägelser finna sin förklaring.

Kloroplasterna och plastidfärgämnena behandlas i ett flertal arbeten av olika författare. Vid studiet av kloroplasternas morfologi (Granick) har elektronmikroskopet kommit till god användning. Bl.a. har uppfattningen, att grana äro morfologiska enheter, kunnat bekräftas. Stor uppmärksamhet ägnas klorofyllets fluorescens och innebörden av densamma, varom meningarna dock gå starkt isär. Å ena sidan hävdas, att det icke existerar experimentella bevis för att fotosyntes och fluorescens äro komplementära företeelser (Livingston, studier in vitro), å andra sidan hävdas, att fluorescensen är ett mått på den fotosyntetiska aktiviteten, varvid en ökning av fluorescensen är förbunden med en nedsättning av fotosyntesen (Katz, Franck). På fluorescensstudier bygger Franck hypotesen, att narkotika kan produceras i växten och adsorberas till klorofyll-proteinytan, varvid den fotosyntetiska aktiviteten nedsättes.

Frågan om kvantumbehovet vid kolsyreassimilationen synes ha aktualiserats, sedan WARBURG i en förnyad undersökning (1948) kunnat bekräfta sina tidigare uppgifter från 1923 om en förbrukning av 4 kvanta per molekyl O_2. Resultatet står icke i överensstämmelse med de amerikanska forskarnas, som med anledning härav upptagit frågan till förnyad prövning. Icke mindre än fyra uppsatser ägnas kvantumbehovet, samtliga utmynnande i det enstämmiga resultatet, att ca 10 ljuskvanta erfordras per molekyl O_2. WARBURGS avvikande värden bero enligt EMERSON på vissa förbiseenden av metodisk art.

Ett flertal uppsatser behandla fotosyntes med den radioaktiva isotopen C^{14}, som till skillnad från den tidigare använda C^{11} har en betryggande lång halveringstid. Även här göra sig tvenne uppfattningar gällande, vilka f.n. synas tämligen oförenliga. Enligt CALVIN och medarbetare uppträder den radioaktiva isotopen i de från andningscykeln välbekanta syrorna, och schemat för fotosyntesen ger närmast intryck av en »omvänd andning». Enligt GAFFRON-gruppen är hela denna uppfattning felaktig, och förekomsten av C^{14} i de ovannämnda syrorna beror på att CALVIN och medarbetare icke förstått skilja mellan respiratorisk och fotosyntetisk CO_2-fixering. Den förra är identisk med den hos heterotrofa organismer så allmänt påvisade kolsyrefixeringen, den senare representerar däremot en speciell process. Det har lyckats GAFFRON-gruppen att isolera en specifik, ännu icke identificerad substans innehållande huvudmängden assimilerat radioaktivt kol. I princip överensstämmer GAFFRON-gruppens resultat med dem, som på sin tid erhållits av RUBEN, KAMEN och HASSID med den kortlivade C^{11}-isotopen.

Ovanstående exempel må räcka som smakprov på innehållet i detta nya arbete. Boken, som förutsätter vissa förkunskaper i ämnet, kan rekommenderas en var som önskar taga del av de senaste resultaten av forskningarna över växternas fotosyntes.

SVEN ALGÉUS.

FLORENCIO BUSTINZA: De Pasteur a Fleming. Los antibióticos antimicrobianos y la penicilina. — Madrid (Editorial Plus-Ultra) 2. ed. 1945. XV+320 sid., 90 fig.+Apéndice 1946, 8 sid.

FLORENCIO BUSTINZA: De Koch a Waksman. La estreptomycina y la lucha contra el »Mycobacterium tuberculosis». — Madrid (Espasa-Calpe, S.A.) 1948. XVI+270 sid., 91 fig.

För icke så länge sedan intogo svamparna en relativt undanskymd plats i flertalet botanisters medvetande, och intresset för dem var på många håll ganska måttligt. Speciellt genom det senaste decenniets utveckling ha emellertid svamparna, särskilt de lägre, på ett helt annat sätt än tidigare kommit in i blickpunkten. Orsaken härtill är framför allt upptäckten av penicillin, streptomycin och andra viktiga antibiotika, men svamparna ha också visat sig vara värdefulla hjälpmedel vid den industriella framställningen av olika enzymer och kemikalier. Användningen vid beredandet av vissa närings- och njutningsmedel är ju däremot känd sedan gammalt.

Den litteratur av mera översiktlig karaktär, som framkommit i detta sammanhang, behandlar hithörande frågor framför allt ur biokemiska, farmako-

logiska eller medicinska synpunkter och är kanske icke alltid så lättillgänglig för icke-specialisten. Det är därför synnerligen tacknämligt, att den spanske växtfysiologen professor F. BUSTINZA i Madrid utgivit två arbeten om penicillin resp. streptomycin, vilka innefatta utblickar även på angränsande områden och erbjuda en utmärkt introduktion till studiet av antibiotika över huvud både för botanikern och den allmänt intresserade naturvetaren utan utpräglat medicinsk inriktning.

Boken om penicillin inledes med en översikt av bakteriernas och svamparnas biologi och biokemi samt deras industriella betydelse. Därefter följer en redogörelse för kemoterapins utveckling, börjande med salvarsan och fortsättande fram till de moderna syntetiska preparaten, sulfanilamider, sulfoner etc. De använda medlens verkningsmekanism och uppkomsten av s.k. kemoresistens behandlas också. Huvuddelen av boken är ägnad åt penicillin, men korta redogörelser lämnas även för andra antibiotika av olika ursprung, såsom klorellin (från algen *Chlorella*), pyocyanin och pyocyanas (*Bacillus pyocyaneus*), tyrocidin och gramicidin (*Bacillus brevis*), aktinomycin och streptotricin (*Actinomyces*-arter) samt ett flertal ämnen från olika mögelarter, såsom aspergillin, spinulosin, fumigatin, notatin och patulin.

Skildringen av penicillin inledes med en historik, som börjar med FLEMINGS upptäckt och fortsätter med FLOREYS och dennes medarbetares insatser i Oxford fram till de stora tekniska landvinningarna i U.S.A. under kriget. Framställningen innefattar i övrigt både mikrobiologiska, biokemiska, tekniska och medicinska data. Bokens användbarhet för den praktiskt arbetande forskaren belyses av att till och med de vanliga biologiska bestämningsmetoderna för penicillin ingående behandlats.

Av största intresse är det omfattande bildmaterialet. Utom instruktiva diagram och schemata över fabrikationsprocesser och praktiska tillämpningar återfinnas ett stort antal bilder från de statliga och industriella forskningslaboratorier, som deltagit i utvecklingen på detta viktiga område. Ett flertal forskareporträtt förhöja framställningens allmänkulturella värde.

Boken om streptomycin är upplagd på liknande sätt som penicillinboken men har fått ett ännu elegantare utförande än denna. Utom historiska data och allmänna synpunkter på de antibiotiskt verksamma ämnena jämte en utförlig framställning rörande streptomycin, dess tillverkning, egenskaper och användning, återfinnes en omfattande översikt även av övriga mot tuberkulosbakterien *in vitro* och *in vivo* verksamma substanser. Av antibiotika mot denna bakterie behandlas sålunda bl.a. tyrotricin (från *Bacillus brevis*), subtilin och bacillin (*Bacillus subtilis*) samt pyolipinsyra (*Bacillus pyocyaneus*), vilken senare isolerades och undersöktes av svenskarna BERGSTRÖM, DAVIDE och THEORELL.

Författaren är att lyckönska till dessa värdefulla och allmänintressanta framställningar av de viktigaste avsnitten av den moderna antibiotikaforskningen, vilka på ett utmärkt sätt berika litteraturen på detta område. Det skulle vara av stort värde, om de båda böckerna genom en översättning gjordes lättare tillgängliga för läsare utanför det iberolatinska språkområdet.

STEN WIEDLING.