

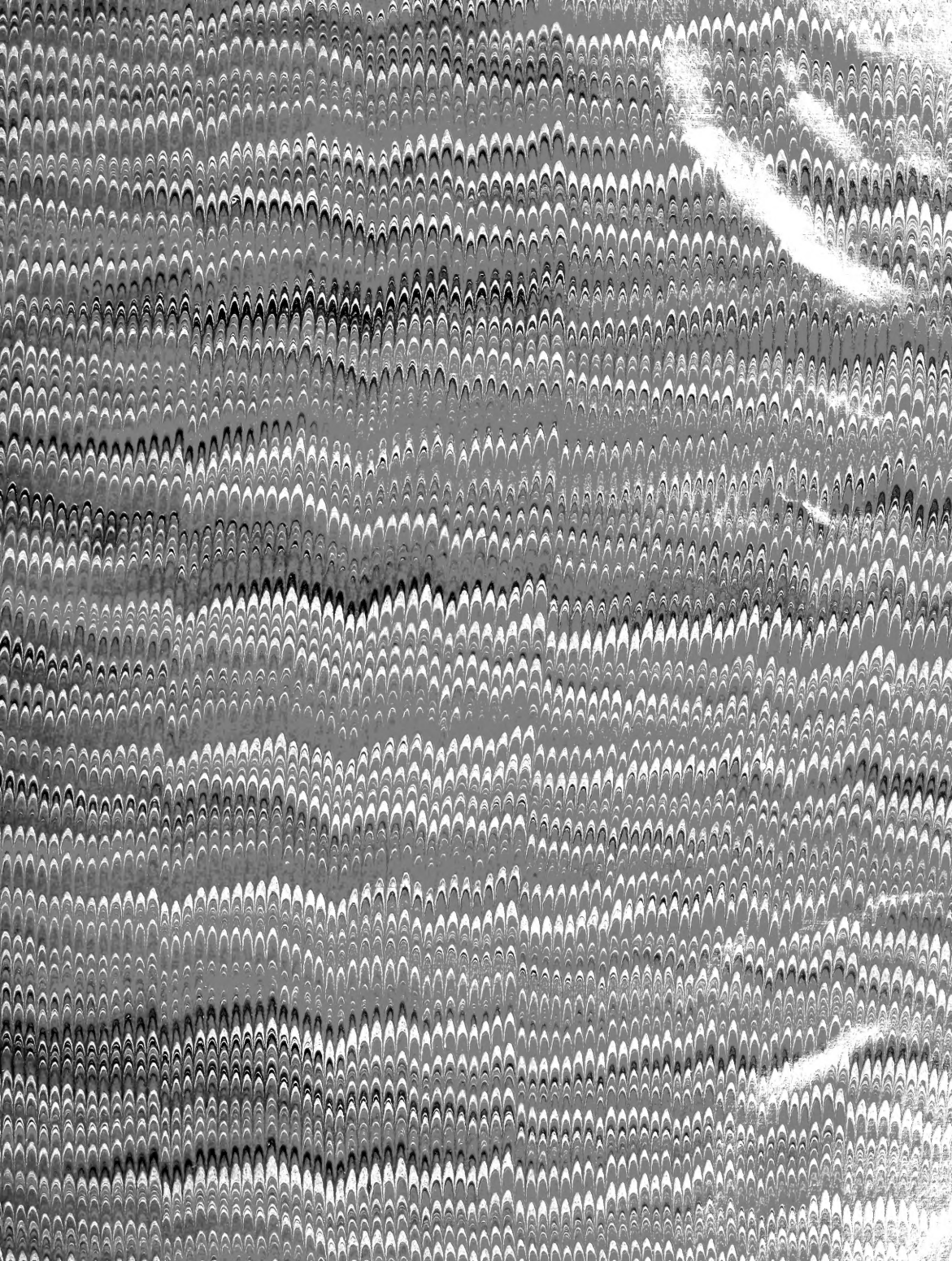
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CONTRIBUTION
TO THE
KNOWLEDGE OF THE DIFFERENT KINDS
OF
BLIGHT IN THE CEREALS
AND
BLIGHT IN GRAIN.

BY A. C. CORDA.

Translated from the German for the Am. Jour. of Agriculture and Science, by

BY E. GOODRICH SMITH,

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PREFACE.

The respected reader will pardon the freedom with which the author seeks to illustrate old long known facts in a way probably somewhat new to the husbandman—and he will find in these sketches simply plain matters of fact without any scientific pedantry. The author has no wish to search into the vast lore, or to reproduce the views of past observers, although he is well acquainted with all the works, even those only partially worthy of notice, from Theophrastus to Strauss, Bulliard, Meyen, Unger, on this subject, among which, the labors of Banks, Fries and Unger, must be considered as the best guides. The author's aim is only to build on the foundations of facts depending on the internal structure and physiological connection, without desiring to admit or oppose the views, theories and so called experiments of others. In all pathological inquiries, besides Prof. Unger, none of the writers with whom I am acquainted have regarded the anatomical structure itself of plants. Usually, the so called experiments are presented which are opposed either by their own obscurity or by similar observation of the same or a succeeding investigator. These views the author of these pages has no wish to appropriate; and, therefore, he begs the respected reader to receive the following pages as the result of more than twenty years' observations, in which time the author has been especially occupied with the study of the parasitic fungi. At the same time, it should be recollected that this first cycle of pathological treatises regards the parasitic forms of disease as a *complete subject*, without any reference to their primitive origin, so far as this is possible; for *to the perfect physiological knowledge of an organic individual belongs previously the entire knowledge of its species and its anatomical structure*; as without these two foundations the author himself can only proceed on baseless views and superficial, wordy talk; and so much the more, if belonging to a certain school, he wishes to gloss over an upright, independent "*il ercio*," with philosophic form. But to the subject;

Vegetable parasites, like the animal ones, form a great and very rich family; and the majority of them belong to the fungi. The same parasites which develop themselves in the texture of our cereals are also the more worthy of notice; and therefore I first of all examined them, and will afterwards also describe and represent the species which habitate in our other vegetables.

The collective specimens of brand belong to a humble family of fungi, to which the natural historian gives the family name of *Caeomacæ*, and all the species of this great family are parasites. They distinguish themselves by the simple characteristics—"single-celled spores or seeds," from all the kindred families to which still by the development of the interior texture of their organism they belong. The most important of these families for our object are the wheat brand, the oat brand, the barley brand, the maize and millet brand. All these belong only to the families of the grasses; and of our cultivated grasses, the rye only is certainly marked as the particular species on which hitherto no species of brand has been discovered; an observation first made by Prof. Kunze of Leipsic, and which I have found confirmed in all parts of central Europe, although many authors also speak of the rye brand as one of the most common appearances. In the level country of Germany and Austria, besides the red stalk brand (*Uredo rubigo*), and the pedicel brand, (*Puccinia graminis*), there is found no brand on rye; and only in cloudy, moist, mountainous regions is there any fungus of the family of the fibrous fungi, (*Tricho vel Hyphomycetes*, Auct.) found on the ears of rye, to which fungus the people improperly give the name of "the rye brand," and which I shall consider specially below. I shall here exhibit besides many illustrations of the definitions of the particular organs and terms of expression; but all these illustrations must be only short here, and can be but imperfectly given; and the reader may obtain an intimate and detailed knowledge of the organs here spoken of in my "Guide to the Study of Mycology," p. 21—36. I will omit the same, and at once proceed to illustrate the form of structure of the various species of brand.

BRAND IN THE CEREALS.

The respected reader of this essay, will pardon the freedom with which the author illustrates an old long known subject, in a manner probably somewhat strange to farmers, or if he should find set down in these sketches only real matters of fact without any display of scientific learning. The author likewise proffers no copious literature or reproduction of the views of past observers, although nearly all the writers on the subject are known to him from *Theophrastus* to *Tessier*, *Strauss*, *Bulliard*, *Meyen* and *Unger*; among whom he would notice the works of *Banks*, *Fries* and *Unger* as the best guides. The author's object is to prepare a foundation of facts derived from the internal structure and physiological texture, without aiming to admit or oppose the views, theories and so-termed knowledge of others. In all pathological inquiries, no one of the authors, so far as I am acquainted, has regarded the anatomical structure of the plants themselves. Usually the so-termed observations are set forth, which are contradicted either by their own obscurity or by similar observations of the author himself, or those of others who succeed him. Such a course does not consist with the views of the author of these pages, and therefore he begs the respected reader to receive the following remarks as the result of more than twenty years' observations, during which period he has been occupied with the particular study of the parasitic fungi. At the same time he wishes this first epitome of pathological investigations into the parasitic

forms of disease, to be regarded as a *complete whole*, without any reference to their primitive origin, so far as this is possible; since *to the perfect physiological knowledge of an organised subject must belong previously the entire knowledge of its nature and anatomical structure*; as without these two foundations the writer can only deal in unfounded suppositions and superficial discourse, full of empty words. This is especially the case if, belonging to a certain school, he is desirous of glossing over a bold, upright admission of his ignorance with philosophical forms. But to our subject.

The vegetable parasites, like the animal, form a large and extremely numerous family of plants, and the greatest portion of them belong to the class of the fungi. Those parasites, which develop themselves in the texture of our grain plants, are by far the most worthy of notice, and therefore I have examined them first of all, and will afterwards describe and delineate the kinds which habitate in our other cultivated plants.

The various kinds of brand collectively belong to a family of fungi of humble rank, which natural historians call by the family name of the *Cacomaceæ*, and all the species of this great family are parasites. They are distinguished from all the kindred families to which they are allied, in their internal organic texture, by the single characteristic that they have solely one-celled spores or seeds. The species of this family, most important for our consideration, are the *Wheat Brand*, the *Oat Brand*, the *Barley Brand*, the *Maize* and *Millet Brands*. All these species habitate only in the family of the grasses, and of our cultivated grasses rye is only to be distinguished as that species on which, up to this time, there has with certainty been found no true species of brand, an observation which was first made by *Prof. Kunze* of Leipsic, and which I have thus far found confirmed in almost all parts of Central Europe, although many writers speak of the rye brand as one of the most common appearances. In the level country of Germany and Austria, besides the red stalk rust (*Uredo rubigo*) and the stalk brand (*Puccinia graminis*), no brand is found on rye; and it is only in the mountainous regions which are cloudy



BRAND IN SERIALS

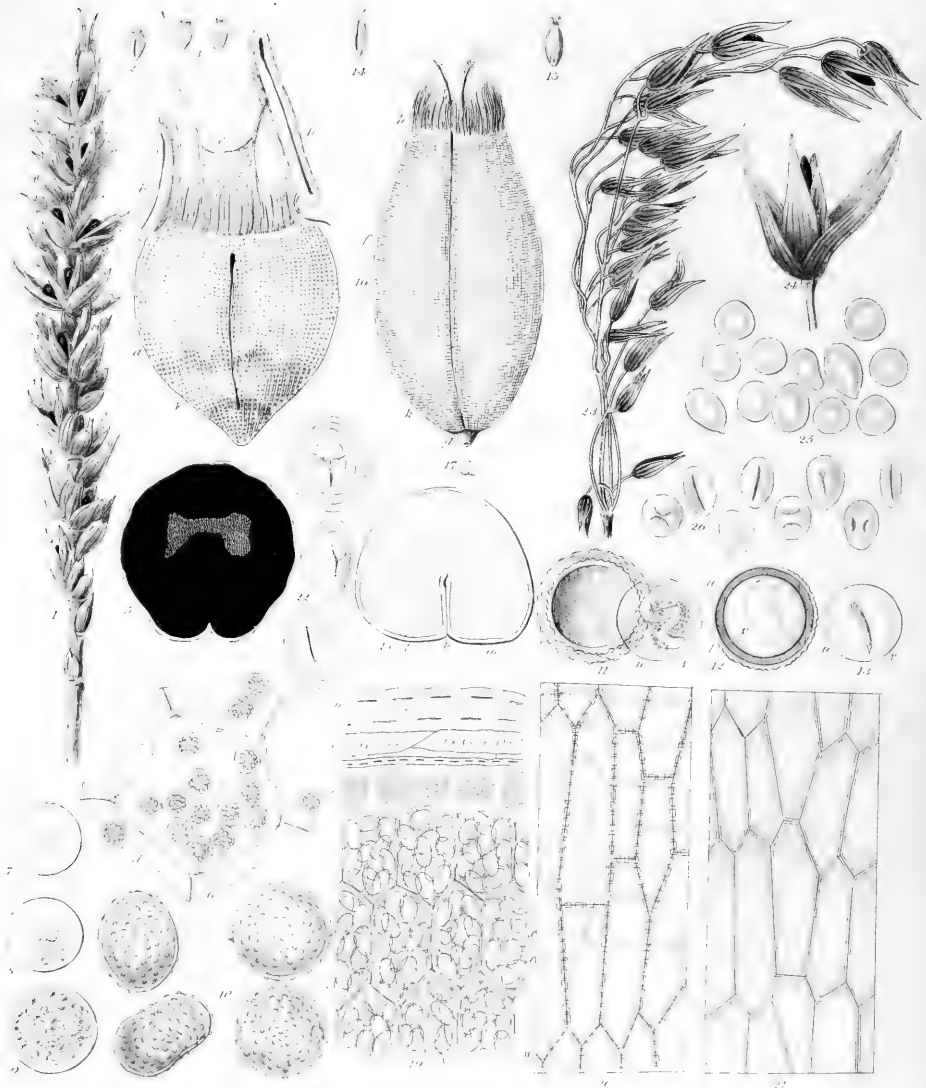


Fig. 1-24. Erioseptaria ditmarii Nutt. *Fig. 25-26. Erioseptaria corda*

and moist, that there is a fungus of the family of the fibrous fungi, (*Tricho vel Hyphomyces Auct.*) which lodges in the ears of rye, and which fungus the common people very incorrectly call the rye brand or smoko brand, and which I shall consider particularly hereafter.

I shall likewise take for granted many explanations of the definitions of particular organs and phraseology; for, as such explanations could only be very short in a periodical journal, they must hence be also imperfect, and the reader may acquire accurate and minute knowledge of the terms here applied to the organs, in my Guide to the Study of Mycology, pages 21-36. I will therefore omit the same, and proceed at once to the description of the structure of the various species of brand.

I. OF THE WHEAT OR SMUT BRAND, (*Uredo Sitophila Dittmar.*)

Plate I. Fig. 1-22.

Among all the species of brand which infest our grain crops, this is by far the most worthy of notice. It lodges only in the ears of wheat, and is found in no other kind of grain or grass. It migrates with wheat in all climates of the earth, without being subject to local influences, as is almost ever the case with the other cultivated plants. The farmer dreads it most, and justly, for being lodged in the ears when they are brought to be threshed, it is there dispersed by the flail or threshing machine, and thus directly infects the sound grain, while the barley and oat brands are for the most part out on the field, and hence the largest portion of the seed of these latter kinds of brand necessarily falls on meadow, forest, or other kinds of soil, which are not applied to the cultivation of grain, and so, for the want of plants adapted to the infection, are not further spread. But the consideration of the infection and transmission of the various species of brand by means of threshing and the sowing of their seeds, I reserve for a more comprehensive subsequent treatise.

Those halms of wheat which afterwards bear ears affected with brand, may be early distinguished, before their bloom, by

their luxuriant growth and their dark green color, as well as by their large, broad, stiff leaves. They apparently bloom much earlier; but very often (yet not always) their anthers contain no grains of pollen (powder of fructification), and the first act of fructification, the shedding of their pollen on the cup of the pistil, is very imperfect, and should the ears affected by the brand and already diseased be dusted with sound pollen, the little balls of pollen, usually form no aggregation of pollen on the pistil, or such as are formed do not press into the pistil and down to the ovary. The fructification of the blossoms of wheat affected by brand is therefore imperfect, and in case the grains of pollen form no cluster in the cup, then there is indeed no fructification. But the careful observer finds on almost all the ears ripe for receiving the grains of brand, on the side of every seed corn affected with brand, one or two anthers (Plate I, Fig. 3, 4, b, b), which on the buds which are well fructified and bear seed, the anthers with their stamens have long since fallen off. The anthers which remain standing on the grains affected with brand, are usually destitute of pollen, and sometimes we find that the same, in consequence of efforts at imperfect fructification, are stuck, as it were, (Fig. 4, b, right side), to the pistils which remain standing (Fig. 4, c). The two pistils which remain standing, of the seed affected with brand, are usually covered and joined together, by delicate white threads interwoven like mould in a sort of network (Plate I, Fig. 4, c). This mould formation belongs essentially to the wheat brand, and forms as it were a part of the root texture of the fungus constituting the brand. It always exists, only frequently more or less developed, and therefore more or less easily found. It wholly covers the head of the seed, and lies between the chaff-hairs (Fig. 16, h), while the sound seed exhibits not a trace of such an interwoven fibrous formation among the chaff-hairs on its head. The same is also the case in respect to the pistils of the sound seed (Fig. 16, i). With the development of this outer fibrous mould begins likewise the transformation of the seed, as well in respect to its external form as to its internal structure.

If the transformation which the seed of wheat undergoes by the

formation of brand, be examined, we find that the particles have undergone either an entire or partial transformation in respect to internal structure, and without here entering on the technological signification of the several parts of the seed, I shall describe the same, in a way generally intelligible, and simply, as should always be done, and so pass over the head as well as the pistil, since they suffer no visible change by the formation of the brand. The same is true of the glumes and petals, the anthers and the spike of the ears themselves.

The fruit or seed of the wheat viewed on the outside, consists of an elongated irregularly egg-shaped body (Fig. 16, f), having on the front surface a streak or furrow lengthwise, (Fig. 16, k), which bears on the point the pistil (Fig. 16, i), and the head (Fig. 16, h).

At the bottom we see on the back, the little shield (Fig. 15), containing the germ, and the front side the little opening, *Feusterchen*, (Fig. 16, g). If the seed is cut across through the middle (Fig. 18), we find that it has an outer skin (Fig. 18, l), which by bending inward forms the furrow lengthwise (k). Inside of this skin are found white hard transparent bodies containing starch-meal which natural historians call the albuminous bodies, "the albumen" of the seed (Fig. 18, m). If now we cut off as thin as possible, a slice perfectly transparent in the direction already mentioned, and examine the same microscopically, we find that,

1. The skin of the seed (Fig. 18, l), consists of three layers, to wit:

- a. The outer layer, (Fig. 19, n);
 - b. The middle layer, (Fig. 19, o); and
 - c. The inner layer, (Fig. 19, p), on which layer immediately lies a large soft cellular strata, which contains the grains of gluten (Fig. 19, q), nearest the inside lie the amyllum cells, containing the starch-meal, (Fig. 19, r, s).
- a. The outer layer of the seed-skin, (Fig. 19, n), consists of two layers of thick-walled porous cells, which stand with their longest diameter parallel to the axis of the seed, and the walls of which

contain slight hollows or little canals, which in a section cut lengthwise and very strongly magnified (Fig. 20, w), give to the cellular walls a form as if they were formed of oblong figures.

b. The second layer (Fig. 19, o) of the seed-skin, consists of similar cells to those of the first layer, only the walls of the cells are not so thick, and the pores, which these walls contain are much more distinctly (Fig. 19, o) to be seen, than is the case in the cellular walls of the first layer of the skin. But the cells of this layer stand with axis of length horizontally to the axis of the first cellular layer and of the seed, and therefore run as it were parallel to outer surface of the seed. In a section lengthwise they resemble even to the direction of the cells of the first layer of cells, and are nearly as large as they are (Fig. 20, x, x).

c. The third layer is extremely soft and somewhat confused. Its cells are so small, that we can discern their hollows only indistinctly and in the form of mere streaks (Fig. 19, p).

2. Directly under this cellular strata or of the seed-skin in general, we find situated the already mentioned cells of gluten, (Fig. 19, q). They are large bag-formed cells, with extremely thin scarcely visible cellular walls, which are filled exclusively with the gluten, a small-grained, greasy, smutty-gray substance, approaching to yellow. Under these cells of gluten lie, first

3. The albuminous bodies of the seed, which consists of large six-sided prismatic cells (Fig. 19, r), the walls of which are soft, clear as glass, and perfectly transparent, and the hollow space in the ripe seed is filled with little grains of starch-meal, (Fig. 19, s; Fig. 22). These latter are round or irregularly egg-shaped, transparent and white, and consist of concentric layers or peels (Fig. 22), the outer of which often bursts or springs open. Between the grains of amyllum or starch-meal are found still smaller grains which consist almost wholly of starch, and must be regarded as little grains of amyllum.

At the base of the seed below the little shield lies the embryo plant or germ; but as the same is scarcely ever found in the bud of wheat which is affected with brand, the consideration of

this here does not belong to the province of this essay, since no immediate transforming influence can be referred to it.

If now after the minute examination of the sound seed, we compare with it the the structure of that which is affected by brand, we find that the diseased seed (Fig. 4), is wholly changed as well in respect to its form as to its structure. It has become shorter and thicker, and not as in the sound seed tapering toward the top (Fig. 16), but increased in thickness (Fig. 4). On its base or on the head, the anthers remain hanging or standing, while in the sound seed they have long since fallen off. The head with the pistil (Fig. 4, c), is broader, and the outer skin (a) of the seed corn affected by brand is rougher and fine punctured.

Let a seed corn thus affected by brand be cut through horizontally, and it be examined under a magnifying glass (Fig. 5), we find outwardly a simple outer skin, and internally a dark black substance often approaching to violet, which is extremely fine grained and greasy, gives out a foul penetrating ammoniacal smell, and on being dried falls to powder. In the middle of the grain affected by brand we generally see a clearer colored square gray spot, which on close examination is found to consist of the remains of the former cellular texture. If now we examine more closely the particular organs of such a kernel affected with brand, we find that the outer skin of the seed thus affected consists of a single stiff layer of cells (Fig. 21), the cells of which in respect to their form and size, resemble much the outer cellular layer of the seed-skin of the sound seed (Fig. 20, w); but their walls are no longer porous, but paper-like, stiff and folded lengthwise; they are not so finely colored, as in the sound seed, but are of a smutty earth color. The second and third cellular layer (Fig. 19, o, p) of the sound seed, has wholly disappeared in the diseased one; the same is true of the cells of gluten, of which not a single trace remains.

On examining still more minutely the black smutty mass, which fills the space designed for the albuminous bodies, we find that here and there it contains some particles of cellular tissue, like the cellular tissue of the albuminous bodies, but the cells themselves

are much widened (Fig. 6, d) and folded. But the hollow spaces, are filled with grains of brand (Fig. 6, e). Should the brand not be fully ripe or developed, we find the cellular tissue still entirely preserved and connected together, but without any traces of amylum. This latter is scarcely ever developed in diseased seed, but in place of it are formed clear globular cells of the same size (Fig. 7), which we instantly distinguish as the young grains of brand. These by form are oily-grained contents (Fig. 7), which increases with the advancing growth of the same (Fig. 8), and their cellular skin previously clear as glass and white, becomes brownish colored. In the later growth we find the entire cells of brand (Fig. 9) filled with little oil-drops, and the cellular wall is of pale violet color, but it is still smooth. These cells, natural historians call the spores or seeds of the fungi which constitute the brand, and in the advancing growth the cellular skin, which is the seed skin of the spore, gradually becomes dark colored and covered with fine warts, while at the same time the little oil-drops visibly increase in the space of the spore-skin, and finally flow into a compact yet scarcely discernible body, (Fig. 10).

But if we thoroughly examine the ripe spores of brand, and we happen to obtain good sections of the same—a problem extremely difficult on account of the minuteness of the body to be cut, and only to be secured by chance—then we see that the spore-skin (Figs. 11, 12, t, t), of the brand-spore forms a dark colored single membrane uneven on the outer surface, which encloses in its hollow space a second transparent cell (Figs. 11, 12, 13, u, u, u), which forms the second or inner spore-skin. But in the space of the second spore skin we find a waxy, curved body (Figs. 11, 13, v, v), which is called the kernel of the spore, and which in spores not yet fully ripe, appears to be surrounded with little drops of oil. The spores compared to other of the different kinds of brand are large and their linear diameter is from 0.000700 to 0.000730 ($\frac{1}{141250}$) of a Paris inch. The spores distinguish this species of brand from all others which habitate wheat, and their specific gravity is greater than that of water; they sink therefore in water, and hence the seed which is affected by brand may be

cleaned with running water, as it is thus also clear that well washed seed suffers less from the brand. But the seed must be thoroughly washed before sowing, in order that the spores of the brand, which may still be in the furrow of the seed and among the chaff-hairs of the head, may be removed.

Here is not the place to quote all the various opinions of the husbandmen and natural historians respecting the existence and propagation of the brand in the various kinds of grain generally. The conviction and view of every individual is so peculiar a matter, which rests on such different grounds of representation and positive induction, that opposition to even the crudest ideas (and so called experience), according to my multifarious observation, is only injurious.

Yet I may be allowed to maintain here as preliminary, that the view which regards the brand merely as a stage of disease, or a disease analogous to the organic diseases of the animals, must indeed be false. I can only compare the parasitic formations which belong to the class of fungi or mushrooms, to the phthiasis or the louse disease, and in this case *no spontaneous generation* is supposed. We have one of the most decisive proofs in the case of a majority of exotic plants which are evidently produced from seed and no parasites (especially eutophytes) have been imported from their native country, while in our glass house all the plants known to me as having been brought alive from the tropic have introduced certain eutophytes peculiar each to its species of plants, and not belonging to this country. The great idea of *De Candolle* "the spreading of the species of brand depends on the sowing of the spores," since the beautiful observations which *Gleichen* published more than sixty years ago, can no more be doubted. This great German natural historian found indeed that the wheat crop strewn and sown with brand dust gave over 50 per cent. of ears affected by brand, while the dry and thoroughly washed seed exhibited scarcely any ears affected by brand.

Besides many eutophytes may be transported, and in the kinds of brand of grain we are by no means justified in denying the transmission by spores, and especially as no husbandman can maintain,

“that he has cultivated wholly clean seed containing not a single brand-spore;” for in practice the extraordinary minuteness of the brand-spores lays an insurmountable obstacle in the way of all observations. The parasites which have their abode in the dead parts of plants may easily be propagated by the sowing of their spores, and a careful observer may in this latter case readily follow the germ of the spores sown, and the gradual development of the parasite through all the stages of its formation, as I have already many times shown in other places. But a multitude of eutophytes besides the sowing by spores also require peculiar conditions of soil and a moist atmosphere for their development; since otherwise the mother plant is not capable of furnishing the nutrition indispensable for its development, or to perform the secretion of the same from its own fluids.

These organic processes necessary to such formations, are yet partially mysteries to natural historians, which may not be laid open by logical phrases, or such as belong to natural philosophy. Only direct observations can here determine, and all views, opinions, belief and so-called experience are positively injurious, while they are almost ever wanting in any strong induction, and under critical examination sink into their original nothingness. It is therefore the wiser openly to admit that we have not yet observed the direct propagation of the kinds of brand by spores, as we must allow on a critical investigation of all circumstances, “*that the conditions of soil, the influence of cultivation, weather, situation and manure which is required for the spreading of the various species of brand, are not fully known.*” Such conclusions are more salutary for the advancement of human knowledge, than all the so-called learned or purely empirical talk.

But since *Ehrenberg* has practically demonstrated the propagation of the infusoria by eggs and division, and I have also the sowing of fungi and mushrooms by spores, we may too hope for a similar proof of the propagation of eutophytes by spores, and until then set aside all speculations on their spontaneous generation as injurious and unnecessary, and the more so as nearly every kind of plant has parasites exclusively having their abode in it, and likewise the soil equally necessary to its development.

Explanation of the Illustrations.

Plate I, fig. 1; an ear affected with brand of the natural size. Figs. 2 and 3, seed kernels affected with brand, with and without anthers, of the natural size. Fig. 4, a seed kernel affected by the brand, greatly magnified; a, the seed kernel with the fold lengthwise; bb, anthers, which stick to the head of the same, and on the pistils, c, interwoven by fungous fibres. Fig. 5, a horizontal section of same greatly magnified. Fig. 6, a cell of this section, with brand-spores, e, greatly magnified. Fig. 7, an entire young brand-spore. Figs. 8, 9, older brand-spores, before the formation of the kernel and spore-skin. Fig. 10, four ripe brand-spores strongly magnified. Fig. 11, section of a spore very greatly magnified; t, spore-skin; u, inner spore-skin; v, kernel of the spore surrounded with little drops of oil. Fig. 12, a single spore of this kind where the kernel of the spore v, with the inner spore-skin u yet lies in the hollow space of the outer spore-skin t. Fig. 13, a kernel of the spore v, represented alone with the inner spore-skin u, greatly magnified. Fig. 14, a sound, ripe wheat kernel, front view. Fig. 15, the same, back view, with the little shield, natural size. Fig. 16, the same, greatly magnified; f, the seed-kernel, with the seed-skin; k, the fold lengthwise; g, the little opening; h, the head; i, the pistils. Fig. 17, horizontal section of the same through the centre, and Fig. 18, slightly magnified; l, the seed skin; k, the fold; m, the albuminous bodies. Fig. 19 a thinner section of the wheat kernel strongly magnified; n, the cellular layers of the first seed skin; o, the second; p, the third or innermost seed skin; g, the cells of gluten; r, the cellular tissue of the albumen with grains of starch-meal, s. Fig. 20, external view of a very delicate vertical section of the seed-skin of a sound kernel of wheat strongly magnified; w, outer cellular layer; xx, inner cellular layer of the same greatly magnified. Fig. 21, the outer skin of a wheat kernel affected with brand of the same ear strongly magnified. Fig. 22, little grains of amyllum very strongly magnified.

II. THE OAT BRAND. (*Uredo Avenæ Corda.*)

Plate I. Figs. 23-26.

Almost all naturalists have confounded this species of brand with the brand (*flug brand*) which lives on barley (*Uredo setum, Pers.*); since in common with this latter it is characterized by scattering the spores, the destruction of the buds, and a certain stunting of the ears. It has its abode almost ever originally in the fruit buds of oats, and afterwards more or less wholly attacks the other parts of the bloom. The outer skin of the fruit buds is destroyed extremely quick, and soon is entirely gone, and before the ears are fully developed the blossom and fruit organs are destroyed even to the outer and inner leaves of the bud (Fig. 24), and the shedding of the pollen of the brand-spores has then commenced. The diseased ears of oats show them at a distance by their stunted spikes and little branches. The fungous brand itself in a ripe state forms a brownish black extremely soft powder, which very rapidly sheds out, and examined by the microscope, consists of very small transparent roundish little grains, which viewed under the water (Fig. 25) are globular or elongated, very often for a time double, and of unequal form and size. Viewed dry or without water (Fig. 26) they still appear in similar forms, but then they are folded over or with curved hollows. They consist of a very delicate single spore-skin, and a spore-kernel almost slimy, filling the whole spore-skin. The spores themselves are very minute; their diameter in the round spores are 0.000270 ($\frac{1}{37157}$) Paris inch, and the longest diameter of the elongated ones only 0.000310 ($\frac{1}{32288}$) Paris inch. They are twice or three times less than the little grains of the wheat brand, and much smaller than the spores of the barley brand which are represented in the plate, and from the latter of which they are distinguished sufficiently in the structure of the spore-kernel. This species of brand resembles the millet brand as little as it does the barley, as the general structure and spores of that brand are both perfectly distinguishable, only the oat brand, the barley brand, and

LEAVES IN CEREALS

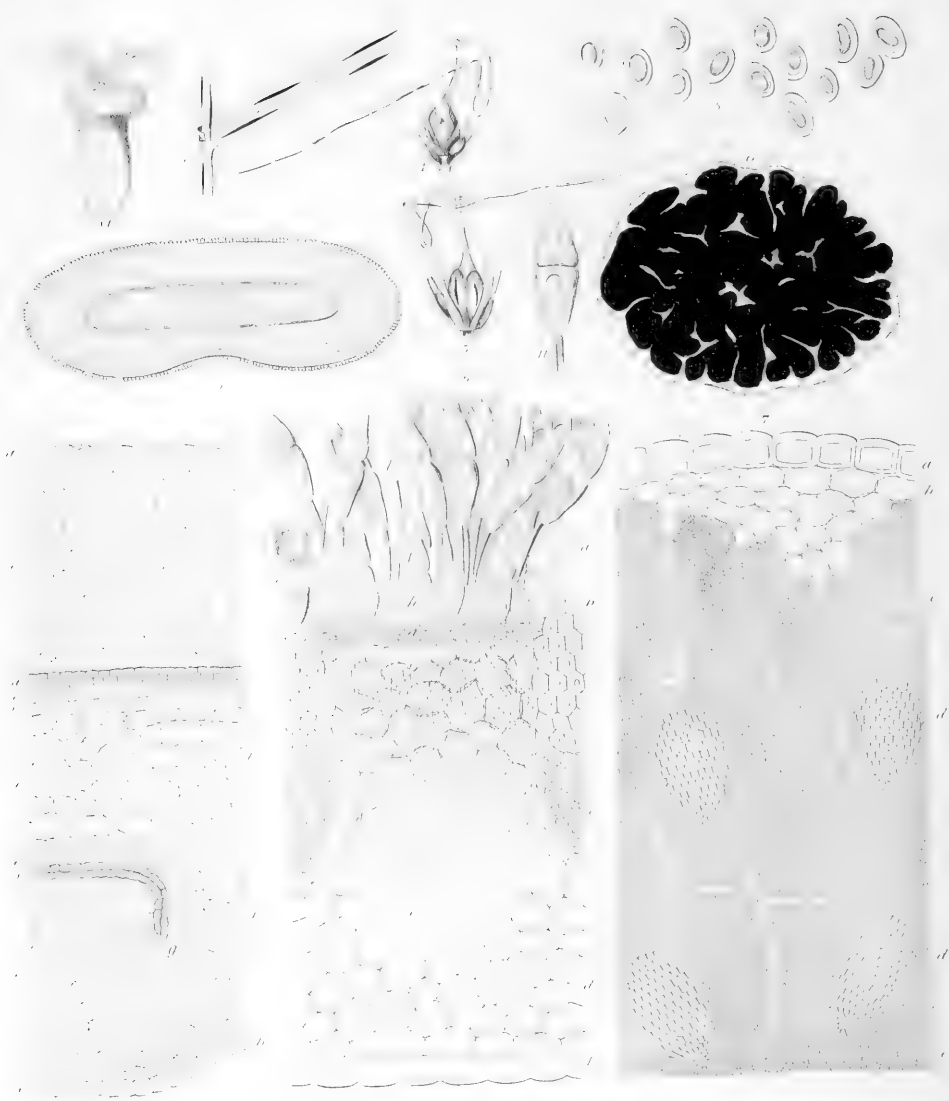


Fig. 1. L. ... Petis Part II. L. ... Petis

the millet brand have smooth spores, though indeed with difficulty to be confounded and compared; the other kinds of brand which have their abode in the buds of our grasses have spores with grained spore-skin, and on this account can neither be confounded nor compared. The oat brand scatters itself early in the field, and it is highly probable, that the spores of all the kinds of brand already shedding their dust on the field remain for years in the soil, retaining their germinating power until their mother plants again come under cultivation there, or that they sow themselves in the yet tender and first ripening seeds of plants in their neighborhood, and thus already lay the germ for the development of their progeny.

Explanation of the Illustrations.

Plate I, Fig. 23, an ear of oats affected with brand, natural size. Fig. 24, a single fruit bud of the same diseased. Fig. 25, spores of the oat brand represented under water and strongly magnified. Fig. 26, the same examined dry and powerfully magnified.

III. THE BARLEY BRAND. *Flug Brand, Nagel Brand, Russ Brand, Rust, Staub Brand.* French—*La Réticulaire des Blés, Charbon, Nielle, Fuligine, Uredo segetum, (Pers.) or Uredo hordei.**

Plate II. Figs. 1—8.

The brand which has its seat in the ears of barley, as we have already mentioned, is by not a few naturalists confounded with many of the other species of brand, which are found in our cultivated grasses. Like the wheat, oat, and millet brands, it inhabits the floral parts, (*blüthenheile*) of the barley, but it causes the most peculiar appearances in the fruit knots, in which it lodges itself. The wheat and oat brands in general, wholly destroy the fruit knots of these two kinds of grain, without causing any new organic formations, except that of the brand. But the case is entirely different, with the barley brand. Here are developed in the fruit knots, new organs, not belonging to the brand, which in

**Tessier. Traite des maladies des grains, page 306, Fig. 2—4.*

The masses of spores of the barley brand (*flug brand*,) itself, forms a disagreeably smutty black mass, varying into an olive green, and the spores on being very strongly magnified are oval, inclining to round bodies (Fig. 8), the clear transparent yellow-brown skin of which, and the spore kernel lying loose and separate, is of a beautiful green color, and under pressure appears to be a tolerably compact wax-like substance. The spores are minute and their diameter varies from 0.000340 to 0.000380 of a Paris inch.

This brand, like the oat brand, sheds its powder on the field before the harvest, and in respect to its seeding, I would express the same opinion I have done in regard to the oat brand. Like all the other kinds of brand, it appears most abundantly in moist cool seasons, on wet soil, and in seed which has been carelessly cleaned or selected.

Explanation of the Illustrations.

Plate II, Fig. 1, a young fruit knot, (or bead) of barley, slightly enlarged. Fig. 2, a section of the same much magnified. Fig. 3, portions of the section marked by the brackets a, a, in Fig. 2, greatly magnified; a, a, the outer skin; b, its bend inward on the outer fold lengthwise of the fruit knot; c, c, the second seed skin on the albumen; d, e, f, the third seed skin formed of three layers which appear open on the side at g; h, the kernel of the plant-egg with the embryo i, i. Figs. 4, 5, seed buds (*blüthen*) of the barley affected by the brand, of the natural size, taken singly from the ear; Fig. 6, section of a fruit knot of barley affected by the brand, and magnified in order to show the outer skin, the white veins and the black masses of brand rolled up together. Fig. 7, a very delicate section of the fruit knot of barley affected by the brand, strongly magnified; a, the outer skin with its almost normal cells only somewhat enlarged; b, the remains of the cellular tissue, large, slight-walled, are derived from the albumen of the fruit knot, and yield no little grains of sap, but a juice clear as water; c, c, the mass of the brand spores; d, d, the abnormal woody bundles, lying between them which, with their narrow ta-

pering side towards the middle of the fruit knot, contain a single vessel, its woody cells small, six-sided and thick walled. Fig. 8, brand spores very greatly magnified in order clearly to show the spore skin and dark spore kernel.

IV. THE STALK BRAND. *Stiel brand of the Grasses, Puccinia graminis (Persoon).*

Plate II. Fig. 9—11.

It infests only the stalk and leaves of our grasses and grain, and forms long, slender, dark-brown, somewhat swollen patches (Fig. 9), which are surrounded lengthwise on both sides by the remains of the outer skin of the stalk or leaves. These patches are formed beneath the outer skin, and before they break forth they appear in dark-brown shining stripes glistening through the outer skin. After they have broken forth, they are conglomerate.

If now by the help of a very sharp razor we cut off a delicate, perfectly transparent section of a culm or haulm affected with the stalk brand, running through a patch on the stalk brand which has already broken through (Fig. 10), we can clearly see its structure.

We see on the side of the patch of stalk brand, the cells of the outer skin (Fig. 10, a), separated and curled up, and also that this separation of the outer skin takes place between the two parallel woody bundles (b), and rarely runs out over an intervening bundle. Directly beneath the outer skin we find the layers of the parasite bearer (g, h), on which stand the spores (l).

But here occurs a very remarkable circumstance. The stalk brand is very rarely indeed a primary parasite on the plant. It is usually a parasite on a parasite, and especially in the *red rust* of the grasses (*Uredo rubigo vera, De Caud*); and the layer of the bearer lying immediately under the outer skin, (Fig. g, h), only directly belong to it, the lowest layer lying on the cellular tissue and destroying it, (g) is flaky, rough (*derbe*) and pale colored; it forms the peculiar bearer (*Hypostroma*) of the fungus. Above develops itself a layer of cells (b), more equal in height, more perpen-

dicular, finer, more fibrous and simple, which naturalists call basilar cells, and between which from some of them are formed by a direct club-shaped enlargement (Fig. 10, i), the spores of the red rust; which continually increase in size and finally become globular and of a deep orange-red (Fig. 10, k). In this mother-fungus the stalk brand as it were, fixes its nidus (Fig. 10, l). Its spores likewise sprout between the basilar cells (h), and rise upward while they form long, delicate stalks, on which they stand singly. But from these stalks also spreads downward through the layers g, and h, of the mother fungus, a fibrous tissue formed of divided fibrous cells, which branch out in many ways (Fig. 10, e), break through and interweave the cellular tissue of the grasses, and thus crowd into the vacancies and hollow spaces of the haulm. Often they press through the entire substance of the plant and form, particularly on the leaves of the grasses, beneath the upper skin of the opposite surfaces of the leaves, only patches of the stalk brand; which then commonly is wanting in the previous red rust. But frequently the upper skin of the opposite surface remains uninjured (Fig. 10, f), while the cellular tissue is not entirely interwoven with the fibrous tissue of the fungus, and only slight discolorations of the portion opposite the parasite, take place.

The spores (Fig. 11), of the stalk brand consist of two somewhat globular cells placed one above the other, with strong, hard, stratified, brown-colored transparent spore skin, that in the upper cells, towards the point, is decidedly thickened. In each one of the two cellular spaces we find a pale colored, waxy, and for the most part egg-shaped or elongated spore kernel. The spore stalk is a glassy, clear, round, fibrous cell, with a minute hollow space. On the base where it passes over into the bearer, it is a little thicker.

The stalk brand is injurious to farmers, only when it affects the straw and meadow grasses, in an extraordinary degree, as such are scarcely ever eaten by cattle. If the straw is employed for the purposes of manufacture, then a very frequent occurrence of this brand is extremely injurious, because the assorting of the straw costs much trouble and labor.

BRAND IN CEREALS

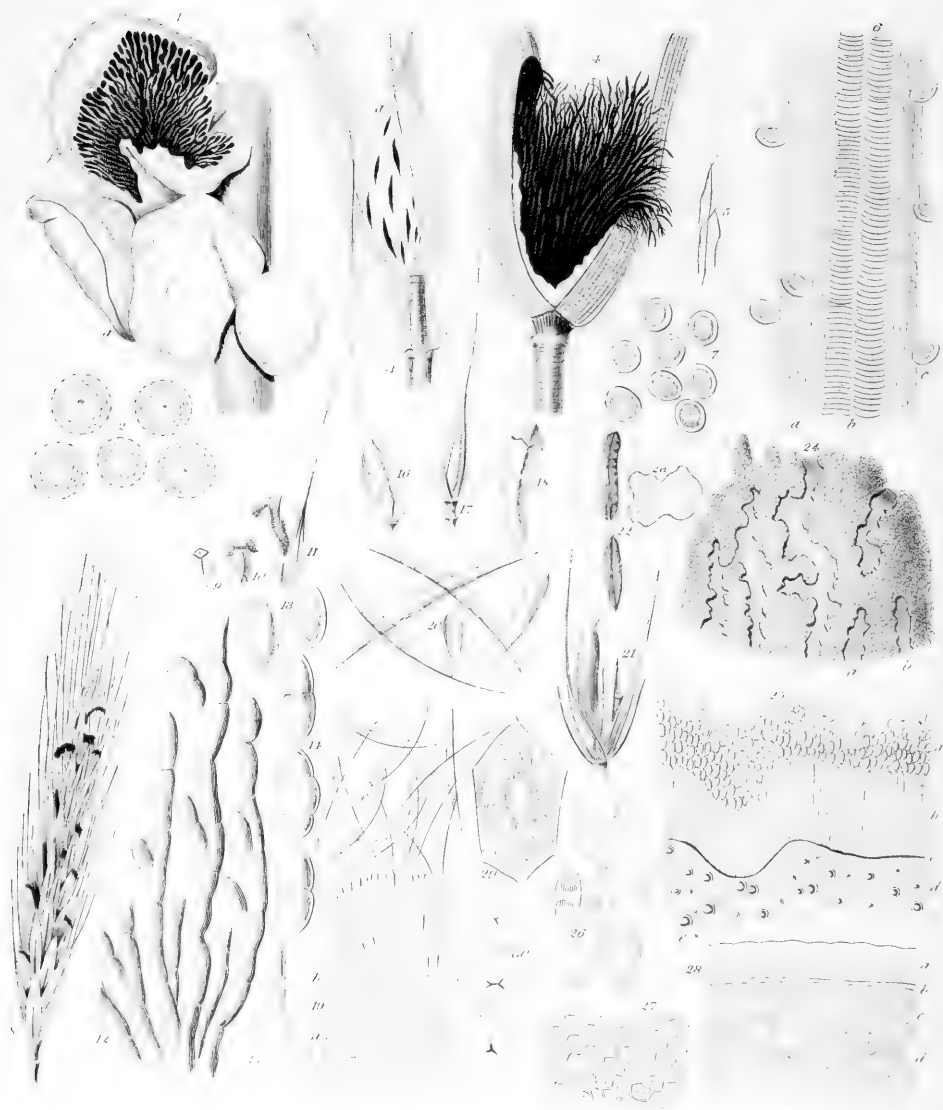


Fig. 1, 2 *Uredo Maydis* Fig. 3, 7 *Uredo destruens* Schlecht Fig. 8, 15 *Cladosporium herbarum* Link
 Fig. 9, 10 *Uredo tritici* Fig. 11, 12 *Uredo hordei* Fig. 13, 14 *Uredo hordei* Fig. 16, 17 *Uredo hordei* Fig. 18, 19 *Uredo hordei* Fig. 20 *Seposporium artemisii* Corda Fig. 21, 30 *Uromyces Clavus* Corda

Explanation of the Illustrations.

Fig. 9, a stalk and part of a leaf affected by the stalk brand, of the natural size. Fig. 10, a delicate section through a patch of the stalk brand on a haulm of rye, magnified; a, the outer skin rolled back by the brand; b, outer cluster of cells in the inner bark (*bartzellenbündel*) of the woody bundle; d, the parenchyma of the haulm; e, the deficiencies in this parenchyma; f, outer skin of the opposite surface; g, the bearer of the red rust; h, the layer of basilar cells; i, the young spores of red rust; k, a ripe spore of the red rust; l, ripe spores of the stalk brand, standing in a patch. Fig. 11, a ripe spore, as above, of the stalk brand, greatly magnified, in order to exhibit the two cells, the cellular kernels, and the spore stalk.

V. THE MAIZE BRAND. *Uredo Maydis*, (*De Candolle*), *U. Zea*,
(*Chevalier*.)

Plate III. Fig. 1—2.

All the species of brand more or less, cause decisive injury to the organs of the plants which they infest. But the maize brand among all the kinds of brand found in our cultivated grasses, produces the greatest and most extensive local transformations. It attacks all the parenchymatous organs of the maize plant and more or less completely destroys them. The stalk, however, the female and male blossoms, are the parts which it most especially affects. The leaves no longer furnish the great parenchymatous masses necessary for their development, and usually it seizes merely on their lowest parts or also only on the husk bearer. But its development here is already imperfect, and it forms on the leaf-organs, only brand bladders of the size of a poppy seed to a pea. In all the parenchymatous organs however, it develops itself in the form of masses, and in good soil, and in actual cultivation of the maize, I have seen brand bladders of the size of a child's head. Its development is a peculiar one, as it forces out great masses of cellular tissue, formed from the tissue of the mother plant, and similar in formation to the latter.

Some parts of the organs affected by the brand swell and become white. The green color and compact formation of the outer skin gradually passes into a soft watery tissue of a silky lustre; the skin of which allows the large cellular formation to be seen through it by the naked eye. If we more closely examine this pathological product, we find that it consists of tolerably large tender walled substance, the cells of which, like that of the normal vegetable tissue, contain sap, and possess a large slimy cellular kernel sticking on the side. In each of these cells at a later period is secreted a slimy granulous substance, which is yellowish, and afterwards brownish, in which still later the brand is developed. Prof. *Meyen* examined this brand formation very critically, and we may here be allowed to repeat his investigations:

At first is seen in the large and juicy cells of the maize plant, or especially in the pathological cellular substance, the above mentioned little deposits of slime, which are produced on the inner surface of the cellular walls. From these, at first wholly irregularly-formed, almost transparent deposits, proceed fibrous, dismembered and branching structures, which already exhibits a plant-like form, and which by their later changes more clearly evidence the same. These truly parasitic formations are in the beginning colorless, almost entirely transparent, and only under a strong magnifying exhibit a fine grained organised structure in their tender, slimy substance. But soon it is observed, that particular boughs of this little plant are branched out, and in individual cases yet more developed, branches and twigs stand closely crowded together. At the same time with this branching, the fibres are already partially separated into small globular bodies, sometimes at the base, and sometimes at the point of the fibres; but for the most part their little side branches first separate off themselves. Many fibres are wholly changed into little branches in a wreathed form, which still hang together. They are originally ellipsoidal and then become more or less globular, are at first of a yellowish and afterwards of a brownish color, and at last brown. But they likewise separate themselves from the branches producing them, and often before they have reached their normal

size, which follows after their separation as it were by a sort of after ripening. By and by all the fibres fall away into such spores or grains of brand; by and by too the cells of the diseased vegetable substance are destroyed, and if we carefully cut through lengthwise (Fig. 1, b), the brand bladders not yet opened or sprung apart (Fig. 1, a); we find that the white cellular substance appears to be interwoven with irregular masses of brand, partially isolated and in the form of cells; the cellular substance which still remains standing, forms white sheath walls, and cells, or better described, deficiencies, the hollow space of which is filled with the dark-brown brand. By and by this remains of the cellular tissue constituting sheath walls, becomes absorbed, and only the outer skin of the brand bladder continues standing; but it begins likewise to be colored reddish, or smutty, to become wrinkled or in folds, to dry up and finally to tear open, by which the substance of the brand spores is emptied and as it were sown out. This species of brand causes manifold degenerations of particular parts and organs of the mother plants. On the stalk it forms irregularly rounded brand bladders, very greatly differing in size. On the female blossoms it never attacks all the blossoms (*blüthen*) of an ear; the blossoms on the top of the ear are for the most part more exposed to the brand than those at the base. Often only those fruit buds that stand at the very tip, and frequently only the basilar ones are diseased. Here the brand attacks only the fruit knot and changes it directly into a brand bladder; so that indeed a person may find on the latter still the remains of the wasted pistil. But the rachis (midrib?) itself I have never found entirely gone. More frequently it seizes on the husk leaves, and then changes the whole ear or the fruit bearing branch into an organ not unlike a pine apple, it thickens all the leaves and forms them similar to the scales of a fir cone. But in the male blossoms (*blüthen*) the brand seizes on the receptacle and the anthers, more rarely the petals, and changes all these organs into white, curled-up, easily-bent brand bladders, one to three lines thick and often two or three inches long, which are likewise white, and of a beautiful silky lustre, slightly tinged with red at the tip and on the side springing open to let out the spores.

The spores (Fig. 2) in their normal state are globular, but they are very frequently likewise somewhat ellipsoidal. In a ripe state they are brown. The spore skin is covered with little warts and on many spores may be observed a dark point in the middle, the little opening (feusterchen? hilum) by which they were fastened to the fibrous bearer. Their diameter varies from 0.000320—0.000340 Paris inch.

This species, always impairs some blossoms, as soon as it is seated in the ear, while the other blossoms standing near bear good ripe kernels. The brand bladders can be very easily removed from the living plants by cutting them out, only this must be done as timely as possible in order that in cutting them out, the bladders may not scatter their powder, and thus a future crop of brand not be prevented. For seed only kernels should be selected from plants which have remained wholly free from the brand. This kind of brand is by the structure of its spores different from all others, and only related to the wheat brand.

Explanation of the Illustrations.

Fig. 1, brand bladders; a, on the stalk of maize of the natural size; b, such a brand bladder cut through lengthwise. Fig. 2, spores strongly magnified.

VI. THE MILLET BRAND. *Uredo destruens*, (*Schlechtendahl*.)

Plate III. Fig. 3—7.

As the maize brand by the formation of a mass of abnormal cellular tissue produces a peculiar covering for itself, even so, or at least analogous thereto, the millet brand produces for itself, its own peculiar covering, in which it enwraps and vitiates the collective organs of blossoming and fructification or of the panicle. Here the original formation enters within the panicle sheath, and the leaves which invest it in its earliest growth; and as soon as the brand reaches the outward surface or becomes visible, it is already perfected and immediately ripe for sowing its seed. It comes forth as a white, thin, oval-elongated body between the capsular leaves of the millet (Fig. 3, a), which on closer exami-

nation appears rough on the outer surface and resembling the outer form of an egg shell. This outer skin is very brittle, and usually becomes split into many wide openings, running lengthwise (Fig. 3) whereby the dark-olive spores are rendered visible. But in the ripening of the brand, this brand covering almost wholly falls to pieces and we find only its scanty remnants of the base. After its destruction the mass of brand appears intersected as it were, by numberless thin sparry fibres, (Fig. 4, 5); these fibres are the woody bundle of the panicle stems (Rispenstiele) which are wholly destroyed up to these. Under the microscope we plainly see, that these fibres (Fig. 6) are the woody bundles divested of the parenchymatous tissue, to which remains nothing but the layer of inner bark, (Fig. 6, a), and the spiral vessels, (Fig. 6, b). But before the observation is made, we must carefully cleanse them from the spores which stick to them (c), and which render impossible any observation, as they surround them with a tolerably strong layer.

The spores (Fig. 7) are oval-globular, smooth, transparent, olive-brown, with large kernels filling the hollow space of the spore skin, and having pretty distinct little openings (feusterchen? hilum) Their diameter varies from 0.000420 to 0.000430 Paris inch.

From the formation of this general covering of the brand skin, the husbandman can very easily keep his millet seed clean from infection; provided he causes the branded ears to be carefully removed in time and burned. But they must not be cast on the dunghills, for multifarious experiments teach that the spores of the fungus will retain their germinating power for years in the earth, and they will even pass through the digestive organs of animals and be discharged perfectly unimpaired and produce new fungi, as I have particularly observed with respect to the common toad stool.

Explanation of the Illustrations.

Fig. 3, a millet plant with the brand a, not yet fully opened. Fig. 4, a brand shedding its powder of the natural size. Fig. 5, single fibres of this brand of the natural size. Fig. 6, such a fibre

magnified; a, the cells of the inner bark; b, the spiral vessels of the woody bundles; c, the brand spores. Fig. 7, spores strongly magnified.

VII. THE RYE BRAND. *Roggen or Rauch brand, Cladosporium herbarum, (Link.)*

Plate III. Fig. 8—15.

It has been already remarked in the Introduction, that the author of these pages has never found rye affected by any kind of brand; which observation has been confirmed, as regards the flug brand in the following words by Prof. Dr. Kunze of Leipsic. "Obs. It is called flug brand by the farmers of Germany. It is remarkable that it never infests the cereal rye. (The Fungi of Germany, No. 9, page 5, Leipsic, Voss., 1819.)*"

When we therefore give to the following parasite the popular name, we by no means wish thereby to discredit the above expressed experience, and would observe that the rauch brand of rye is no species of brand, but is a kind of fungus. It affects rye in moist cloudy seasons, and is especially found in narrow high mountain valleys. It is not developed in the tissue of the mother plant, but it seats itself on its upper surface, and only sends the fibres of its root-texture into the substance of the mother plant. In rye this parasite nevertheless hinders the full ripening of the grain, and the seeds of the ears attacked by it are small, stunted, horny, and give a poor flour which is still more affected by the parasite, as the washing and moistening of the grain before grinding, cannot remove it; but on the contrary fixes it more firmly than before.

This brand, the rauch brand, belongs to the fibrous fungi and appears at first as a slight blackening of the ears, as soon as these begin to ripen and turn yellow. In its developed state it forms on the ears irregularly shaped rough masses (Fig. 18), of a dark-

* Obs. Flug brand, ab agricolis Germanial vocatur. Insigne, quod Leate, cereale nunquam infestat. (Deutschlands Schwamm. No 9, s. 5, Leipsic, Voss., 1819.)

olive color varying to a blackish hue. This seats itself especially on the heads of the seed corns (Fig. 9, 10, 11), and only in its very highest development passes over to the other parts of the fruit bud and unites itself with them. If we closely examine this olive-green substance, we find that it consists of perpendicular articulated olive-green, transparent fibres (Fig. 12), which develop on their points elongated spores that afterwards fall off and appear scattered in among the fibres. These spores are sometimes one celled (Fig. 13), sometimes two and three celled (Fig. 14), and are light olive-green, smooth, with a delicate spore skin. In every spore cell is found a slimy spore kernel filling the hollow space. The diameter lengthwise of the spores varies from 0.000-300 to 0.000860 Paris inch. The spores sprout again on the ears still standing in the field (Fig. 15), while one of their cells spreads out sideways and forms an articulated cellular fibre, like the fibre of the developed fungus (Fig. 12), which in moist and warm weather in the course of twenty-four hours again produces a new plant and new spores. This rapid reproduction makes this fungus so injurious in moist warm autumn weather, and if the grain comes to the threshing in a moist state, the fungus also increases in a truly frightful manner, indeed in damp granaries, or when the kernels are somewhat moist it increases most extraordinarily and sticks the kernels together.

Explanation of the Illustrations.

Fig. 8, an ear affected by the rauch brand of the natural size. Figs. 9, 10, 11, seeds and fruit buds (*blüthen*) of rye, affected by the rauch brand of the natural size. Fig. 12, single fibres of the fungus with spores. Fig. 13, single celled. Fig. 14, many celled spores much magnified. Fig. 15, a germinating spore of the rauch brand greatly magnified.

VIII. THE RED CORN BRAND. *Spindel brand, Septo sporium graminum* (Corda). *Fusarium heterosporum* (Nees).

Plate III. Fig. 16—20.

This parasite likewise belongs not to the species of brand, but to the fungi on the outer skin (*haut pillzen*). It appears on the fruit knots of the grasses, especially of the ray grasses, and of rye, and forms on the same, a deep-red, compact, afterwards confluent, moist gelatinous mass, which, generally, is from two to three times, but often becomes half an inch long, and sticks together the parts of the fruit bud (*blüthenthiele*). The kernels or seed of the grasses when they are attacked by this fungus appear swelled up and deformed (Figs. 16, 17, 18), and their outer skin is wholly impaired, while the albuminous substance remains totally unaltered, and the starchmeal also undergoes no perceptible deterioration. The fungus itself, as seen in their sections under a microscope, forms directly over the destroyed seed skin, a confused cellular, fleshy, thin, reddish-white layer (Fig. 19 a); on which the cells forming the spores called basidal (Fig. 19, b), are developed, as single separate fibres. These cells form on their tops and partly between themselves, long spindle-shaped, four-celled, transparent, pale-red spores (Fig. 19 b, 20 c), tapering at both ends, of from 0,00090 to 0.00110 Paris inch in length; which when balled up together compose the deep-red cover of the fungus. Between the spores are often found wasted three-celled or single-celled egg-shaped spores (Fig. 20). The fungus itself is not injurious, but on damp meadows it often to a considerable extent, deteriorates the ears of ray grasses; on rye I have seen it to appear abundantly, only in quite elevated situations on the borders of the rye culture.

Explanation of the Illustrations.

Figs. 16, 17, 18, single degenerated seeds of rye affected by the fungus of the natural size. Fig. 19, a thinner section of the fungus magnified; a, the fleshy bearer, the basidæ; c, the spores. Fig. 20, single spores much magnified.

IX. THE ERGOT. *Mutter korn, Kormz apfen, Roggen mutter, Martin's korn, Halinsporn, Todtenkopf, Gersten mutter, &c. Hymenula Clavus (Corda). French—Ergot, (Tessier, Malad. des grains, p. 21). English—Cockspur, Black grain of corn, Ergot.*

Plate III. Fig. 21—30.

This disease so noxious to our cultivated grasses ever since the time of Tessier, has been investigated, in various forms, as to its natural history by *Queckett, Bauer, Fee* and *Léveillé*, and the illustrations of it as well as the hypotheses of its origin have induced critical study respecting this so simple fungus. More particularly has the transformation of the seed in the fungus been subjected to examination; but without any previous decided knowledge of natural history, and the microscopic analyses, have been very negligently performed by naturalists. On the other hand however, it has been carefully inquired, whether or not this or that part of the seed was contained, and could be discovered in the ergot. Similar has been the case with the investigation of the parasite which causes this deformity, it exhibits numerous names of naturalists because they have made no perfect analysis of the fungus. The reader who may be interested in the contradictory opinions, often expressed, may find the same scattered through the following works:

MEYEN ueber das Mutter korn, in Müller's archiv. for Anatomie und Physiologie, 1838, § 357.

SPIERING de Lecale cornuto. Diss. inaug. Berol. 1839. *Léveillé* Memoires sur l'ergot. In the Mém. de la Societ. Liénoise de Paris, v. p. 365.

Phoebus, Teutsche Giftgewachse, 1838, p. 97.

Meyen, Pflanzenpathologie, 1841, p. 195.

Observations on the cause of Ergot, by Mr. James Smith, A. L. S., Linnean Society Trans. XVIII. 3 p. 449.

Observations on the Ergot of Rye and some other Grasses, by Edwin J. Queckett, Esq., F. L. S. (Linn. Tr. 1 c. p. 475.)

For the sake of brevity I shall here omit all the opinions and views, and only relate what I have myself observed, and can also be responsible for, little as it may indeed be.

If we closely examine the seed affected by the ergot, we find it covered with a bluish-gray growth, resembling down, which is easily wiped off, whereby the dark-violet color of the layer beneath is made to appear. In many seeds we see the pistil still remaining and thickened towards the top (Fig. 21), but in all these are yet found traces of the little shield (*schildchen*), (Fig. 22), at the base of the fungus. Viewed in the section, the fungus forms a white, compact homogenous mass, which at the first appears to be composed of the dark line of the basilar layer, and from the middle to the margin exhibits yellow, unequally connected rays (Fig. 23). On considering the outer surface still more closely, the ergot, in almost all the portions I have seen, is found covered with four furrows, or cracks on the side lengthways, which often penetrate through the black covering. If now we examine the individual parts of the already ripened kernel from without, with the microscope, we find that the rime, or white growth, is spread in fine downy masses (Fig. 24, a), over the black covering b, and that it is formed from the fruit bed (*frucht-lager*) of the fungus which thus transforms the seed. Cut off a very thin section; but it must be taken off through the fine downy mass of the fruit bed, without destroying it; we find on examining from the interior outward, (1), that the *inner white mass* of the ergot consists of an extraordinarily fine cellular tissue (Fig. 25, d), which in section under water, gives out drops of oil more or less large (Fig. 25, e). This viewed by a stronger magnifier, consists of small six-angled somewhat thick-walled cells (Fig. 27), each of which contains within it one or two little drops of oil. The oil is yellowish, and on the light being passed through it, greenish. This mass of cellular tissue forms the peculiar bearer of the fungus, and as it were runs into the stem and cap, and towards the outside terminates in a dark black line (Fig. 25, c), which consists of a simple layer of black cells, imparts the black color to the fungus seen from without, and forms an extremely thin layer, on which (2) the fruit bed (*frucht-lager*) of the fungus toward the outside rests. This consists of a single layer of fibrous, single celled undivided basidial cells (Fig. 25, b), of white color, which towards the upper part produce and accumulate the spores (Fig.

25, a, 3). The spores form fine down that may be rubbed off, on the spurred grain, and to this is to be attributed in a great degree the poisonous effects of the ergot. They are, viewed when powerfully magnified (Fig. 26) elongated, ellipsoidal, often curled up on the side, smooth, greenish-white; their spore skin is extraordinarily delicate, transparent, lying close to the crooked, greenish, wax-like, transparent spore kernels, and frequently containing two greenish little drops of oil. The spores are from 0.00030 to 0.00035 Paris inch in length. When placed on fresh moist fruit knots or on other portions of the plant, they germinate with extraordinary rapidity and on the object bearer of the microscope under water we can see them germinate also in twelve to twenty-four hours, while they lengthen out one or two points of their spore skin into fibres, and these fibres afterwards open into cells, whereby from the branching out at the openings as it were, a new root texture is formed for the future fungus. It is a matter of regret that Messrs. *Queckett's* and *Francis Bauer's* illustrations of this microscopic process are so unsatisfactory. I shall repeat them elsewhere after my own observations.

According to my accurately made analysis, the fungus belongs to the species *Hymenula* among the fleshy fungi, where also on decaying remains of plants it has a multitude of associates, which likewise greatly impair and destroy their mother plants and lodging places. The noxious quality of the fungus as well as its medicinal use I take for granted to be already well known, and will now pass over to the comparison of the appearances in the diseased and the sound seed, in order to sketch the injurious power of this hardly visible parasite.

If a thin section of a sound kernel of rye be made (Fig. 28), we find that the seed skin (Fig. 28, a), consists of three thick walled cellular layers, and beneath these we find the second seed skin, properly the third, formed of a single layer of thick walled cells b, with scarcely any perceptible hollows. Directly after this follow the cellular layer, containing gluten c, and now first the cellular tissue of the albuminous substance d, which con-

sists of large, somewhat round, six-sided cells, containing grains of starch meal (Fig. 26). The grains of starch meal themselves are roundish or ellipsoidal (Fig. 30), and formed like all other grains of starch meal; they are 0.000150 Paris inch in length, and are thus nearly five times larger than the spores of the parasite itself.

But all these organic tissues are transformed, or as it may be better expressed, entirely crowded out. The seed skins and cells of gluten (Fig. 23, a, b, c) in the parasite, are only indicated by the black layer (Fig. 25, c); the large cells (Fig. 28, d, Fig. 29) of the albuminous substance together with their amyllum have disappeared, and are replaced by the cells of the bearer (Fig. 27) nearly fifty times less in size. The amyllum here, as the contents of the cells, is replaced, as it were, by the little drops of oil contained in the cells of the bearer. And as the organization of the seed is wholly changed, so too are the organic effects of the two substances become different. The grain of rye was nutritious, palatable, healthy; the spurred rye (*Mutter korn*) is in the highest degree noxious, poisonous, the means of producing raphanic, insanity, and abortion; its medicinal usefulness is by no means a counterbalance to the dangerous, poisonous effects, which it produces when introduced among human food.

I conclude here the first course of investigations respecting the diseased appearance of plants generally, and once more beg of the respected reader to judge candidly and favorably of these desultory pages, and to receive the matters of fact related and illustrated without any fanciful forms of knowledge, as the pure observations of nature. Elsewhere when I shall consider these appearances in their most intimate connections with the functions of life, of the vegetable organization, collectively, these same may be more extensively estimated and the appearances, here only slightly indicated, then by an accurate anatomico-physiological delineation of the general organization, may receive their far more natural and comprehensive explanations and illustrations. The respected reader will probably thank me for having here avoided all foreign

observations, and that I have only given my own experience, and kindly acknowledge it, since I have performed my work to the best of my ability.

Explanation of the Illustrations.

Figs. 21, 22, the spurred rye in its natural size. Fig. 23, a section of the same seen under a microscope and slightly magnified. Fig. 24, the top of a spurred rye-kernel seen under the microscope greatly magnified, in order to show the layers of spores b, and the bearer a. Fig. 25, a thinner section of the spurred rye very strongly magnified; a, the layer of spores; b, the basidal cells; c, the outer skin of the bearer; d, substance of the bearer; e, little drops of oil from the substance of the bearer, with the oil bearing cells powerfully magnified. Fig. 28, a thin section from a ripe kernel of rye much magnified; a, the seed skin; b, the inner seed skin; c, cellular layers of gluten; d, albuminous substance formed from the cells that bear starchmeal. Fig. 29, a cell of albuminous substance with grains of amyllum very strongly magnified. Fig. 30, single grains of amyllum of rye very strongly magnified.

TRANSLATOR'S ADDRESS.

The readers of the Journal who have examined the article now first offered to the public in an English dress, will doubtless have noticed the use of some words which are new to our language. Those only who have attempted to transfer a scientific essay from one language to another can fully appreciate the difficulties under which a translator labors in finding the requisite words to express his meaning. Especially is this true in respect to the production of many German writers. The investigations are carried out into such minuteness of detail, that no corresponding terms are in use among us to give the precise shades of thought implied in their compound words. For example the words *Blüthen*, *Blüthenthiele*, *Frucht knoten*, *Frucht boden*, *Feusterchen*, &c., in certain modes of using them, mean a particular state of the floral or fructified plant, for which we have no appropriate words. The meaning,

is perhaps evident in the course of the observations of the author and by a referencé to the illustrations. Our German dictionaries are wanting in many of these scientific words. I have availed myself of such helps as were within my command, and in view of the difficulties of the subject have sometimes ventured to give only a literal translation by a similar form of compound, leaving the connexion to show the meaning. In some few instances, after all the pains I have taken to arrive at the precise sense, I am not quite certain that I have gained my object. In the main however, I believe that the article will be found to be accurately translated, and as such, cannot but hope that it will be regarded as not an unworthy addition to the stock of information respecting the diseases of our most important cereals.

Since I have been engaged in this translation, I have met with an essay by the same author on the Potato Disease, characterised by the minuteness of investigation and accuracy of discrimination which is so evident in the foregoing pages; and illustrated by a number of plates, some of them colored, giving the microscopic appearances observed. At some future period, when my time will allow, I may prepare for the press this article on the Potato Disease, with perhaps a few other valuable selections from the German economists and naturalists.

CONTRIBUTION
TO THE
KNOWLEDGE OF THE DIFFERENT KINDS
OF
BRAND IN THE CEREALS
AND
BLIGHT IN GRAIN.

BY A. C. CORDA.

Translated from the German for the Am. Jour. of Agriculture and Science, by

BY E. GOODRICH SMITH,

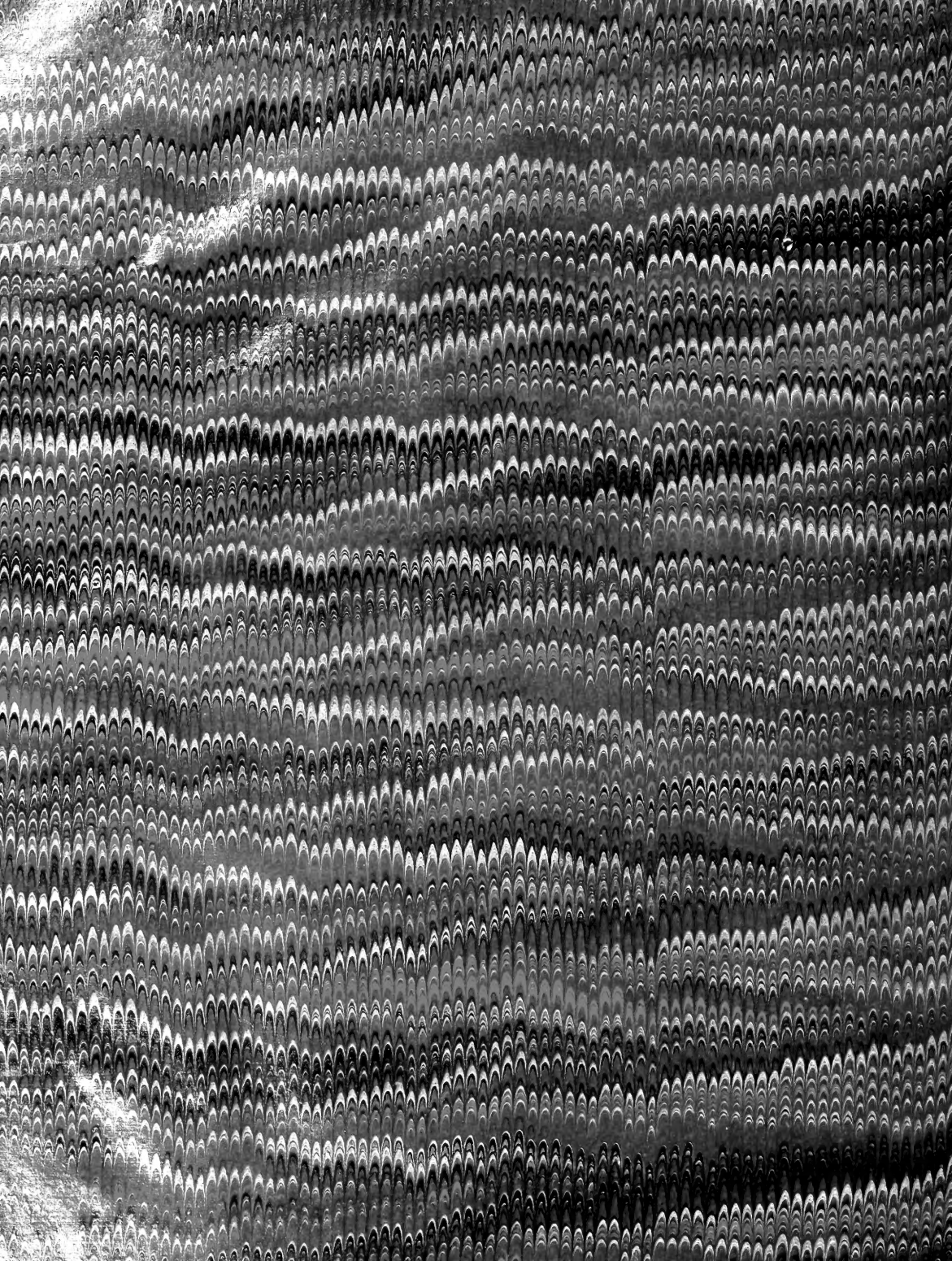
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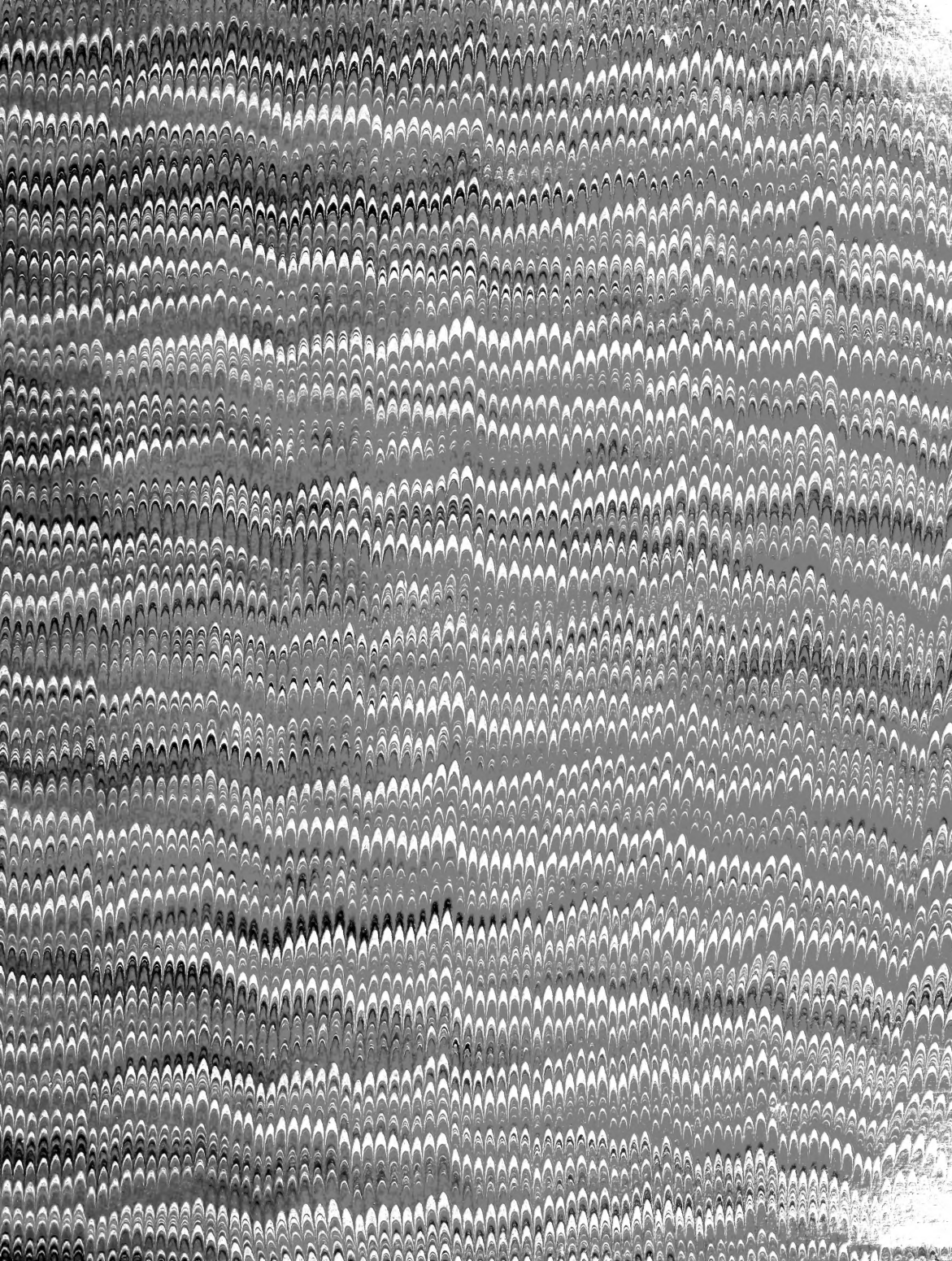
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