hours has taken to itself all the protoplasm, secreted a dense envelope, and is a ripe ovoid spore, smaller than the mother-cell, and lying loosely in it (*cf.* figs. 9, 11, and 12). In the case of the simplest and most minute Schizomycetes (*Micrococcus*, &c.) no definite spores have been discovered; any one of the vegetative micrococci may commence a new series of cells by growth and division. We may call these forms "asporous," at any rate provisionally.

The spore may be formed in short or long segments, the cell-wall of which may undergo change of form to accommodate itself to the contents. As a rule only one spore is formed in a cell, and the process usually takes place in a bacillar segment. In some cases the spore-forming protoplasm gives a blue reaction with iodine solutions. The spores may be developed in cells which are actively swarming, the movements not being interfered with by the process (fig. 5, D). The so-called "Köpfchenbacterien" of older writers are simply bacterioid segments with a spore at one end, the mother cell-wall having adapted itself to the outline of the spore (fig. 5, F). The ripe spores of Schizomycetes are spherical, ovoid, or long-ovoid in shape, and extremely minute (*e.g.*, those of *Bacillus subtilis* measure 0·0012 mm. long by 0·0006 mm. broad according to Zopf), highly refractive and colourless (or very dark, probably owing to the high index of refraction and minute size). The membrane may be relatively thick, and even exhibit shells or strata.

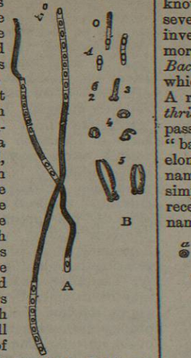

Fig. 11.—A, *Bacillus anthracis*. (After De Bary.) Two of the long filaments (B, fig. 10), in which spores are being developed. The specimen was cultivated in broth, and the spores are drawn a little too small—they should be of the same diameter transversely as the segments. (× 600.) B, *Bacillus subtilis*. (After De Bary.) 1, fragments of filaments with ripe spores; 2–5, successive stages in the germination of the spores, the remains of the spore attached to the germinal rodlets. (× 600.)

The germination of the spores has now been observed in several forms with care. The spores are capable of germination at once, or they may be kept for months and even years, and are very resistent against desiccation, heat and cold, &c. In a suitable medium and at a proper temperature the germination is completed in a few hours. The spore swells and elongates, and the contents grow forth to a cell like that which produced it, in some cases clearly breaking through the membrane, the remains of which may be

Fig. 12.—*Bacillus subtilis*. (After Strasburger). A, zoogloea pellicle (× 300). B, motile rodlets (× 1000). C, development of spores (× 800).

seen attached to the young germinal rodlet (figs. 5, 9, and 11); in other cases the surrounding membrane of the spore swells and dissolves. The germinal cell then grows forth into the forms typical for the particular Schizomycete concerned.[1]

Pleomorphism.—As already stated, some Schizomycetes have been shown to present as vegetative forms, or phases in one and the same life-history, "cocci," "bacteria," "leptothrix-filaments," and even spiral and curved forms known as "spirillum," "vibrio," &c. On the other hand, several Schizomycetes which have been long and diligently investigated by the best observers show no such pleomorphism. As examples of the latter we may select *Bacillus megaterium* (fig. 9) and numerous *Micrococci* which produce similar cells generation after generation. A remarkable example of a pleomorphic form is *Cladothrix dichotoma* (fig. 16). According to Zopf this species passes successively through the stages known as "coccus," "bacterioid," "bacillar," and "leptothrix," by mere elongation and division by transverse septa; the observer named declares that these simple filaments have formerly received generic and specific names (*Leptothrix varasitica*

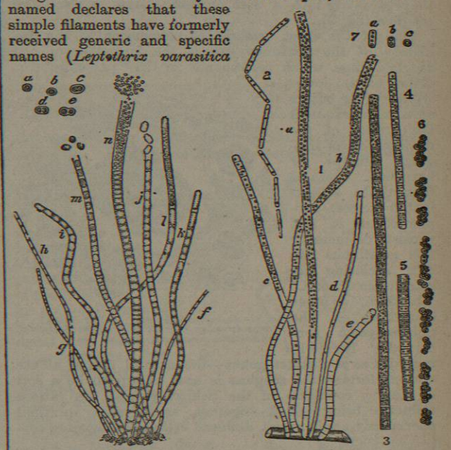

Fig. 13.

Fig. 14.

Fig. 13.—*Crenothrix Kühniana*. *a* to *e*, cocci or spores,—*c*, *d*, and *e*, dividing; *f* to *n*, filamentous stages. The filaments vary in shape, diameter, &c., and are fixed below; at *i* to *n* is seen the common investing sheath; *m* and *j*, the segments separating and escaping; in *n* the segments divide up still further before escaping as minute *cocci* or spores—all stages of division are seen. (× 600.)

Fig. 14.—*Beggiatoa alba*. (After Zopf.) 1, a group of attached filaments (× 540); 2, a filament breaking up; 3, 4, 5, portions of filaments treated with methyl-violet so as to show the septa, which are usually obscured by the sulphur granules in the filaments; in 5 some of the segments are undergoing longitudinal as well as transverse divisions prior to forming cocci (spores); 6, cocci becoming isolated (× 300).

and *L. ochracea*, Kütz.). Certain of the threads then partially break up, and the portions become slightly displaced from the linear series; these portions go on growing in a direction at an angle with the previous one, but still in contact, and thus produce the "false-branching" to which *Cladothrix* owes its name. Finally the filaments break up into segments corresponding with the septa which have been formed across them. This fragmentation is peculiar in that the filaments separate first into shorter filaments, then into rodlets, and finally into "cocci." Portions of the filaments or branches may become separated and travel with a gliding movement, or even become more active and swarm by means of cilia. Such portions may break up into shorter filaments or rods which also

[1] Cohn, *Beiträge zur Biologie*, passim; Zopf, *Die Spaltpilze*, 3d ed., 1885; De Bary, *Morph. und Biol. der Pilze*, &c., 1884, and *Vorlesungen über Bacterien*, 1885. The enormous and scattered literature on the morphology of Schizomycetes is collected to a great extent in the works cited.

swarm. But, in addition to these straight and more or less rigid forms (which, it will be noticed, simulate Ehrenberg and Cohn's "genera" *Micrococcus*, *Bacterium*, *Bacillus*, and *Leptothrix* so closely that any of them observed alone would undoubtedly have been formerly placed apart in one of those "genera"), it is interesting to find that some of the filaments become spirally twisted and simulate *Spirillum*, *Spirochæte*, and *Vibrio*, the distinctions depending on the relative length and thickness of the filament, and the closeness or steepness of the coils. Moreover these twisted filaments also break up into shorter gliding or ciliated portions, which at length fall into rodlets and "cocci" as before.

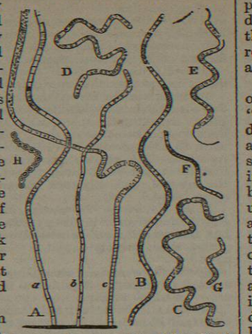

Fig. 15.—*Beggiatoa alba*. (After Zopf.) Curved and spiral forms. C, D, separated spirally-wound pieces, which are breaking up still further in H. E, motile *spirillum* form with a cilium at each end. (× 540.)

A branched zoogloea form also occurs, and this contains cocci, bacterium-like or bacillar rods, or filaments resembling *Leptothrix* or *Vibrio* according to circumstances. In Lankester's *Bacterium rubescens* we have another species which is variable in a high degree. Many other Schizomycetes have now been shown to be more or less pleomorphic, and the researches of Lankester, Nägeli, Zopf, Miller, Kurth, De Bary, and others have laid the foundation for a knowledge of the circumstances which induce the changes in form referred to; it is at least certain that alterations in the nutritive medium, in the quantity of oxygen at the disposal of the organism, and in the temperature, &c., play their part in the matter.

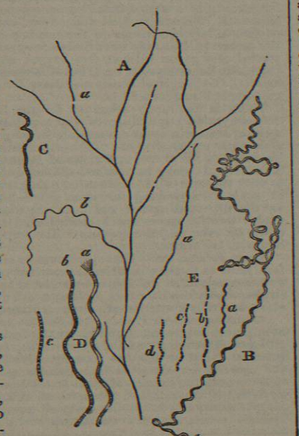

Fig. 16.—*Cladothrix dichotoma*. A, branched plant, the branches in part spiral and of the form known as *Vibrio* (*a*) or *Spirillum* (*b*) (slightly magnified). B, a long coiled branch more highly magnified. C, portion of branch resembling *Spirillum* at one end and *Vibrio* at the other. D, coiled branches.—*a*, not segmented; *b*, *c*, segmented into rodlets and cocci. E, *Spirochæte*-like portions breaking up into rodlets and cocci.

It by no means follows, however, that because some species are pleomorphic all must be so, and still less that no species of Schizomycetes—or only one—exist at all; those who deny the existence of species among the Schizomycetes on the evidence to hand must, to be logically consistent, deny the existence of species altogether. But even if that be allowed, some name of similar intention must be employed to denote any group of organisms which within our experience exhibit periodical repetitions of a process of development, *i.e.*, all the individuals of successive generations go through the same phases periodically. It matters not that variations—ill-defined deviations from an average or "type"—occur on the part of individuals or generations; the periodically repeated life-history or development marks what we term a species.

The difficulties presented by such minute and simple organisms as the Schizomycetes are due partly to the few "characters" which they possess, and partly to the dangers of error in manipulating them; it is anything but an easy matter either to trace the whole development of a single form or to recognize with certainty any one stage in the development unless the others are known. This being the case, and having regard to the minuteness and ubiquity of these organisms, we should be very careful in accepting evidence as to the continuity or otherwise of any two forms which falls short of direct and uninterrupted observation. The outcome of all these considerations is that, while recognizing that the "genera" and "species" as defined by Cohn must be recast, we are not warranted in uniting any forms the continuity of which has not been directly observed; or, at any rate, the strictest rules should be followed in accepting the evidence adduced to render the union of any forms probable.[1]

Classification.—The limits of this article prevent our examining in detail the system of classification proposed by Cohn, or the modifications of it followed by other authorities. Zopf, in the third edition of his work (1885), proposes a scheme based on the modern views as to the pleomorphism: we must refer to the original for the details, simply remarking that, apart from the extreme views accepted by the author, his system is impracticable to a degree and recognized by him as provisional only. Indeed any such classification must be provisional, for we are at the threshold only of a knowledge of the Schizomycetes.

The best starting-point for a modern classification of these organisms is that suggested by De Bary—the two modes of formation of the spores,—and as a provisional scheme, and simply to facilitate comparison of the groups, we might perhaps employ De Bary's two groups, and a third one to include those simple forms which show no trace of spore-formation. Many gaps exist, and many changes will probably have to be made. Meanwhile it might be advisable to classify the Schizomycetes provisionally as follows:—

Group A. Asporeæ.

There are no spores distinct from the vegetative cells.

I. Coccaceæ (figs. 6 and 7).
Genera: 1, *Micrococcus* (and *Streptococcus*); 2, *Sarcina* (and Zopf's *Merismopedia*); 3, *Ascococcus*.

Group B. Arthrosporeæ (De Bary).

The vegetative cells differ in shape, size, growth, or other characters from the spores: the latter are produced by segmentation.

II. Arthrobacteriaceæ.
Genera: 4, *Bacterium* (fig. 8); 5, *Leuconostoc*; 6, *Spirochæte* (?).

III. Leptotricheæ.
Genera: 7, *Crenothrix* (fig. 13); 8, *Beggiatoa* (figs. 14 and 15); 9, *Phragmidothrix* (?); 10, *Leptothrix*.

IV. Cladotricheæ.
Genus: 11, *Cladothrix* (fig. 16).

Group C. Endosporeæ (De Bary).
Genera: 12 (figs. 9–12), *Bacillus* (and *Clostridium*); 13, *Vibrio* (?); 14, *Spirillum* (at least in part).[2]

[1] Ray Lankester, *Quart. Jour. Micr. Sc.*, 1873 and 1876; Nägeli and Buchner, *Niedere Pilze*, 1882; Billroth, *Untersuchungen über die Vegetationsformen der Coccobacteria septica*, Berlin, 1874; Klebs, numerous papers in *Archiv f. exp. Pathol. und Pharmacol.*; Kurth, *Bot. Zeitung*, 1883; Prazmowski, *Biol. Centralblatt*, 1884; Zopf, *Zur Morph. der Spaltpflanzen*, Leipsic, 1882; Cienkowski, *Zur Morphologie d. Bacterien*, 1876.

[2] For the definitions of the genera (and species) the reader is referred to the special works, especially those of Zopf and De Bary; also Winter-Rabenhorst, *Kryptogamen Flora—Pilze*, 1., 1881; and Grove, *Synopsis of the Bacteria and Yeast-Fungi*, 1884.

PHYSIOLOGY.—As in the case of other plants, we are here concerned with the functions of the Schizomycetes and their relations to the environment; for convenience, the subject may be treated under various headings. Limitation of space prevents our doing more than touch lightly upon such matters as the action of the Schizomycetes as ferments, and their relations to disease, though both subjects belong strictly to the physiology of their nutrition and actions on the environment.

Nutrition.—Having no chlorophyll, the Schizomycetes of course depend on other organisms for their carbonaceous food, and are either saprophytes—*i.e.*, live on the remains of dead organisms—or parasites—*i.e.*, obtain their food direct from living organisms. Pasteur, Nägeli, and others have shown that these organisms can derive their carbon from very numerous and widely different organic substances, *e.g.*, sugars of all kinds, mannite, glycerine, tartaric and other vegetable acids, &c., and even from ethyl-alcohol, benzoic, salicylic, and carbolic acids to some extent. Carbonic, formic, and oxalic acids, cyanogen, urea, and oxamide are, however, useless for this purpose. The nitrogen and carbon together may be obtained from leucin, asparagin, methylamine, &c., or the nitrogen alone from these or urea, and compounds of ammonia with vegetable acids or phosphorus. The best nutritive substances are proteids (peptones) and sugars (glucoses); others must be passed over here. The nature of the particular Schizomycete has to be studied as well as the solution, and external agents affect the matter also. Certain minerals are of course necessary,—sulphur, phosphorus, potassium (or rubidium or cæsium), and calcium (or magnesium, barium, or strontium) being indispensable. As one of many suitable nutritive solutions we may select the following:—

Di-potassium phosphate	0·20 gramm.
Magnesium sulphate	0·04 ,,
Calcium chloride	0·02 ,,
Peptone	1·00 ,,
Water	100·00 ,,

For other solutions, particulars as to changes of concentration, &c., and the peculiarities of different Schizomycetes in this connexion, special works must be consulted.

The chief sources of error in cultures of these very minute forms are the introduction of spores, &c., from without into the vessels, and on the instruments, &c., and the difficulty of continuously observing a developing individual with the necessary high powers. Numerous errors have arisen from inferences being employed to fill up gaps in life-histories which have only been partly observed. The first object of the cultivator, then, is to guarantee the purity of his materials, instruments, &c., and then to keep one form (or even a single specimen) under observation for a sufficiently long period and under suitable conditions. The practical difficulties are enormous, of course, and are very rarely entirely overcome for periods at all long. Here again we must refer to the special works for details as to the beautiful and refined methods now devised or employed by De Bary, Cohn, Koch, Brefeld, Lister, Nägeli, and others, calling special attention to the gelatine method devised by Vittadini and Brefeld and so successfully used and improved by Koch. Thoroughly conducted cultivations should decide in what medium the Schizomycete flourishes best, and how it behaves in others,—what vegetative forms it presents normally, and how changes in the environment affect these. They should also decide the characters of the aggregates or colonies; at what temperatures germination, growth, division, spore-formation, &c., take place or cease, and so on; the necessity or otherwise of free oxygen; the effects of the organism on its substratum or medium—whether it cause fermentation, or putrefaction, or excrete soluble ferments, and so on. Moreover, the products of these actions should be examined in detail. Where the particular Schizomycete is a parasite (wholly or partially) the methods of culture are even more refined. Here the fluids or tissues of the host must be regarded as a soil in which (by means of "infection," "inoculation," &c.) the observer sows the spores or vegetative cells of the parasitic organism. It is impossible to go more into details in the limits of this article, however, and we must dismiss the subject with the remark that, having regard to the complexity of the medium (*e.g.*, blood) and the organization of the host, the difficulties of manipulation become greater than ever.

Temperature.—As with other plants, so with the Schizomycetes, their various functions, *e.g.*, germination, growth, division, formation of spores, &c., can only be carried on at certain temperatures: the best average temperature is about 35° C., but the optimum may differ for each species and for each function. The same is generally true for the minimum and maximum temperatures, which have to be determined separately also. Remarkable phenomena are connected with the death-points of certain *Bacilli*, &c. The spores of some of these forms have been frozen for days or weeks without injury, and some are said to have resisted temperatures as low as −100° C., or even lower: it appears to be all but impossible to kill such spores by cold. High temperatures are more fatal; but the spores of *Bacilli* have germinated after the fluid containing them was boiled for an hour, and even a temperature of 110° C. and higher has been withstood. The vegetative states are less resistent; nevertheless the bacilli of anthrax were not killed by heating the fluid to 75–80° for an hour or more. Speaking generally, ripe spores are most resistent and germinating ones least so; dry cells or spores resist extreme temperatures better than normally saturated ones. Of course time is an important factor; and other conditions also affect the matter, *e.g.*, slightly acid media are more fatal than neutral or feebly alkaline ones, denser less so than thin ones (*cæteris paribus*), and so on.

To illustrate the importance of these facts we may note Tyndall's method of "discontinuous heating": by boiling the solutions containing the spores for 5–10 minutes daily all the life was destroyed in two or three days, though an exposure of an hour or more to a temperature of 100° C. did not kill the spores if not repeated. The explanation is that the spores which resist the first or second short boiling have time to begin germinating in the intervals, and they then succumb at once when the liquid is again boiled.[1]

Light, Electricity, Gravitation, &c.—The relations between these and the functions of Schizomycetes have been partly investigated, but the results must be passed over here. A few of the higher genera show polarity—or at any rate difference between base and apex.[2]

Effects of Chemical Agents.—Oxygen.—Pasteur showed that, while Chemistry. some Schizomycetes require free oxygen-like other plants, there are some which need none, or at most very little—the extreme case is perhaps still doubtful; but "anaerobiotic" forms like *Bacillus butyricus* stand in sharp contrast to such exquisitely "aerobiotic" ones as *Bacterium aceti*, *Bacillus subtilis*, &c. A few are known to flourish best—or at any rate they are more active—when supplied with oxygen in proportion less than that in the atmosphere. Engelmann showed that, while some species congregated close to a bubble of air, others collected at a certain distance from it, and came nearer when the bubble contained less oxygen. The same is true for the same species when brought near an *Alga* which is evolving oxygen—the aerobiotic forms collect where the oxygen is being evolved (in the yellow-red, &c., of the spectrum). Some Schizomycetes are powerful deoxidizing and reducing agents: it has already been stated that *Beggiatoa* deposits pure sulphur in its filaments. *Bacterium aceti* and others, on the contrary, transfer oxygen in large quantities to the medium in which they live, and the carbon in that may be entirely consumed. Fermentation once started may go on without free oxygen or not (according to the particular Schizomycete, &c.), but it is necessary at the commencement. Oxygen is of course necessary for the respiration of the growing Schizomycete.[3]

Water is absolutely necessary for the life and growth of the Schizomycetes, but the spores (and to a less extent the vegetative cells) of some can resist desiccation for long periods; others (*e.g.*, *Bacterium zopfii*) soon die. Those of *Bacillus subtilis* have been kept air-dry for years; and those of *B. anthracis* were not killed after several weeks in absolute alcohol. A year in water failed to kill the spores of *B. subtilis*. *Zoogloea* and vegetative cells of some resist drying for some time—how long is uncertain. In the dry state spores and cells are disseminated by currents of air: how far spores may be buried and still retain life (carried down by rain, &c.) is uncertain. The importance of these facts, however, is obvious.[4]

Acids, Poisons, &c.—The reader must be referred to the literature for details as to the quantities of acids and other products of their own decomposition which can be endured by given Schizomycetes (see especially the literature on fermentation and cultivation, and also respecting the action of poisons, antiseptics, &c.).[5]

Attraction towards Proteid Food-Substances.—Bacteria have long been known to swarm around pieces of organic food-materials, but although Ehrenberg and Cohn noticed the fact it was not investigated in detail until quite recently. Pfeffer finds that *Bacteria* and *Spirilla* are attracted in a definite manner towards minute tubes containing extract of meat or solution of asparagin, just as he finds antherozoids and zoospores of various kinds attracted by definite substances into tubes designed to imitate archegonia. For Pfeffer's proofs that the substances mentioned exert a specific attraction on the organism the reader is referred to his treatise, "Locomotorische Richtungsbewegungen durch chemische Reize," in *Unters. aus dem bot. Inst. zu Tübingen*, i. Hft. 3, 1884.

Fermentation.

Fermentation and Putrefaction.—The growth and development of a Schizomycete in any organic medium results in a breaking down of the complex food-materials into simpler bodies, which may then become oxidized and still further decomposed. Such processes are known as fermentation in the wider sense. The particular kind of fermentation depends on the medium and on the species of Schizomycete, and may be affected by other circumstances; as the process goes on volatile substances may escape and others remain behind. Where proteid substances are being decomposed by Schizomycetes and evil-smelling gases escape, the fermentation is spoken of as putrefaction; in certain cases, where intense oxidation follows and still further consumes the products of decomposition, the process has been termed eremacausis. In a few instances a process of reduction sets in, as when sulphur salts are decomposed by *Beggiatoa*. The theory of FERMENTATION (*q.v.*) cannot be treated in detail here, but it is important to note that side by side with the actions referred to another kind of action may go on. Many Schizomycetes excrete what are called "soluble ferments," which are capable of changing proteids into peptones, sugar into glucose, and so on. These processes of inversion, &c., result simply in an alteration of the proteid, &c., from the non-diffusible and non-assimilable condition to the diffusible and assimilable one, and are in no way destructive as are the fermentations described above. Nevertheless it is the custom to speak of both as cases of fermentation; the one series of changes renders the medium less and less capable of supporting life at every stage, the other series does not do so, yet the same name is frequently given to both kinds of action. It is a curious fact that the same Schizomycete may produce a different fermentation in each of two different media. The various fermentations are distinguished and valued according to the products which result; these bye-products are usually injurious to the ferment organism as they accumulate, and often complicate the investigation.

Of important fermentations due to Schizomycetes may be mentioned those concerned in the making of vinegar and cheese, in the preparation of flax, hemp, &c., in the souring and diseases of beer, wines, &c., the destruction of sugars, preserved food, &c. Others are of importance in the soil, and in the destruction of organic matter in ponds, rivers, drains, &c. In fact, much of the *raison d'être* of sanitary science may be referred here; and it may turn out to be still more true than we now know that Schizomycetes are important in agriculture.

In pathology the changes due to these organisms are at length being duly recognized. Apart from the comparatively harmless actions of those forms normally existing in the alimentary canal—*Leptothrix* aids in the decay of teeth, &c.—it is now certain that some invasions are dangerous. The injurious effects of some Schizomycetes when introduced into open wounds, &c., against which the brilliant labours of Lister have been so successfully directed, are acknowledged everywhere; but it is important to recognize that on the whole the diseases due to organisms in the blood depend fundamentally upon changes of the same category as those referred to. Of course the fluids of a living body present complicated conditions, and the action of a pathogenous Schizomycete cannot be treated and studied simply as a typical fermentation; but, although the conditions presented are involved and special, it cannot be doubted that common principles lie at the base of all the phenomena, and that the fluids of the diseased organism must be treated, so to speak, as fermentable media.

Numerous other fermentations of scientific interest are due to Schizomycetes: *e.g.*, those in which colours are formed, certain cases of phosphorescence, the ammoniacal fermentation of urine, &c.[1]

SCHIZOMYCETES AND DISEASE.—The presence of Schizomycetes in the blood, tissues, or organs of animals and man suffering from certain specific diseases is admitted, and has naturally suggested the question—Are they accompaniments only or have they any causal relations to the diseased conditions? Their constancy in given cases excluded the former view. Next arose the discussion as to how the causal connexion comes about and in what it consists, a discussion which is still going on as to the details. The chief points now established may be expressed generally somewhat as follows.

In a given specific disease, due to the action of a definite Schizomycete, the latter may be conceived to be injurious in several ways. If it robs the blood or tissues of oxygen or of any other valuable constituent, or if its activity results in the excretion of poisonous substances or in their formation as products of degradation of the matrix, or if it simply acts more or less as a mechanical obstruction or irritant,—in any of these cases harm may result to the delicately adjusted organism of the host. It being known that Schizomycetes act thus in nutrient pabula outside the body, their rapid growth and multiplication inside can of course only be explained as due to their success in the pabula there met with, and are indications that they produce changes there which must result in abnormality so far as the host is concerned. This does not end the matter, however. The living tissues of a healthy animal exert actions which are antagonistic to those of the parasitic invader; and it is now generally admitted that the mere admission of a Schizomycete into an animal does not necessarily cause disease. Were it otherwise it is difficult to see how the higher organisms could escape at all. Schizomycetes abound all over, about and around us; many, of course, are unable to live in the fluids of the body, but many are able to do so. Something must therefore be placed to the action of the tissues of the host, which when healthy can "resist" the attempts of a Schizomycete to settle, grow, and multiply with fatal effect. Much can undoubtedly be explained by this struggle for existence between the cells of the parasite and those of the healthy tissues invaded. But the higher organisms, again, present obstacles of other kinds to the lodgment of Schizomycetes: ciliary actions, active excretions, isolating processes of tissue-formation, &c., may be mentioned. Thus not every Schizomycete met with in the body can do harm.

But even when a Schizomycete has gained access to the blood-vessels, lymph-passages, &c., and has succeeded in establishing itself and multiplying, there are other facts to be taken into account before we dismiss the question as to its relations to disease. The rapidity of its growth may vary according to many circumstances,—temperature, oxidation, &c.,—as well as the still partially obstructive action of the invaded organism; whether the parasite excretes a poison, or simply robs the host, or distributes injurious agents of any kind, it is clear that everything which favours it aids in intensifying its action. And this may be local or general also according to complex circumstances. Of course sores, open wounds, &c., may render the access of a given Schizomycete very easy, and pave the way for its success in the tissues, &c., different strata of which may be exerting less and less resistance to its attacks. The study of this subject has led to the methods of modern surgery devised by Lister. It may be mentioned that Schizomycetes which produce bad effects on injured or dead tissues of wounds are not necessarily able to live in the healthy organism, however deadly the poisonous products of their action may be when they succeed in establishing themselves.

All these and many other facts, then, point to the conclusion that the mere presence of a Schizomycete in an organ or tissue is not sufficient proof of its causal relation to disease, and lead us to the following requirements to be satisfied before any such relation can be admitted (Koch):—(1) given a specific disease in which a definite Schizomycete is constantly detected, and with a constant disposition with respect to the tissues, organs, &c.,—this organism should be absent from animals free from the disease; (2) the Schizomycete should be cultivated in nutrient media outside the body, kept pure for several "generations," and obtained in some quantity by these means; (3) inoculation of a small amount of this pure cultivation should reproduce the specific disease in a healthy animal; (4) the same foreign elements as before should be clearly detected in the tissues of the now diseased subject, and in the same relations as before.

The satisfying of all these requirements is difficult, and the necessity of overcoming the difficulties has led to what may almost be termed a special branch of medical art. At the same time the majority of the principles which are here becoming recognized have long been known to biologists, and especially to botanists, and there are still numerous indications of a want of botanical training on the part of writers on these subjects. It is impossible here to even mention all the methods devised for staining, preparing, and examining tissues, &c., and the Schizomycetes they contain, or for cultivating these minute organisms under constant conditions on sterilized potatoes, bread-paste, jelly, blood-serum, &c., or in animal infusions or fluids, &c. Some of the more important points in cultivation have already been referred to; the literature must be consulted for further details.[2]

(H. M. W.)

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[1] See Cohn, *Beitr. zur Biol. d. Pfl.*, i. Hft. 2, 1872, ii. Hft. 2, 1876; Eidam, *Beitr. zur Biol.*, i. Hft. 3, 1875; Brefeld, *Unters. über Schimmelpilze*, iv.; Tyndall, *Floating Matter of the Air*, 1881; Roberts, *Phil. Trans.*, 1874; Pasteur, *Ann. de Chimie*, 1862.

[2] See Pasteur, *Comptes Rendus*, 1861–62; Nägeli, *Theorie der Gährung*, 1879; Schützenberger, *Fermentation*, 1876; Engelmann, *Bot. Zeitung*, 1881 and 1882; Pfeffer, *Pflanzenphysiologie*, 1881.

[3] See Pasteur, *Comptes Rendus*, 1863; Kuth, "Bacterium zopfii," in *Bot. Zeitung*, 1883; Brefeld, *Schimmelpilze*, iv.; see also the literature on distribution and occurrence of Schizomycetes.

[4] See Woodhead and Hare, *Pathological Mycology*, i., 1885. Further literature is there quoted.

[1] Watson Cheyne, *Antiseptic Surgery*, 1882; Duclaux, *Chimie Biologique*, 1883; Fitz, "Ueber Schizomyceten-Gährungen," various papers in *Ber. d. deutsch. chem. Gesellschaft*, 1876–1884; Lister, *Pharm. Jour.*, 1877; Nägeli, *Theorie der Gährung*, 1879; Wortmann, *Zeitschr. f. physiol. Chemie*, vi.; Schützenberger, *Fermentation*, 1876; Musculus, "Ueber die Gährung des Harnstoffs," in *Pflüger's Archiv*, xii.; Pasteur, *Ann. de Chim. et Phys.*, 1858, and various papers in *Comptes Rendus*, also *Études sur la Bière*, 1876, and *Études sur le Vin*, 1866; Schlössing and Müntz, *Comptes Rendus*, lxxxiv., lxxxix.; *Pasteur: his Life and Labours*, London, 1885; Schroeter in Cohn's *Beitr. zur Biol.*, Hft. 2, 1872; Van Tieghem, "Bacillus Amylobacter," in *Comptes Rendus*, 1879.

[2] Only a few authorities can be mentioned here, for the literature on pathogenous Schizomycetes and methods is simply enormous; further references may be made to the works of Babes, Koch, Davaine, Pasteur, Chauveau, Bollinger, Fehleisen, Klein, Gaffky, Miller, Rosenbach, Oertel, Obermeyer, Burdon-Sanderson, Toussaint, Waldeyer, Watson Cheyne, Dreschfeld, and many others. Flügge, "Ferment und Mikroparasiten," in Ziemssen's *Handbuch der Hygiene*, Leipsic, 1883; Magnin, *Les Bacteries*, Paris, 1878; Klein, *Micro-organisms and Disease*, 1884; Woodhead and Hare, *Pathological Mycology*, 1885. Valuable papers are also to be found in the following periodicals:—*Brit. Med. Jour.*, *Trans. of the Pathol. Soc.*, *Virchow's Archiv*, *Archiv f. exp. Pathol.*, *Centralbl. f. d. med. Wiss.*, *Bull. de l'Acad. de Med.*, *Deutsche med. Wochenschrift*, *The Lancet*, *Quart. Jour. of Micr. Sc.*, and others.

SCHLAGINTWEIT-SAKÜNLÜNSKI, HERMANN VON (1826–1882), the eldest of a band of brothers, all more or less noted as scientific explorers or students of foreign countries, sons of an oculist of Munich. Hermann was born on the 13th of May 1826. His first scientific labours were studies in the Alps, carried on between 1846 and 1848 in association with his brother Adolf (born January 9, 1829). The publication of the *Studien über die physikalische Geographie der Alpen* in 1850 founded the scientific reputation of the two brothers, and their reputation was increased by their subsequent investigations in the same field, in which the third brother Robert (born Oct. 27, 1837) also took part. Soon after the publication of the *Neue Untersuchungen über die phys. Geog. u. Geol. der Alpen* (1854, 4to), the three brothers received, on the recommendation of Alex. von Humboldt, a commission from the East India Company to travel for scientific purposes in their territory, and more particularly to make observations on terrestrial magnetism. Their explorations extended over the period 1854–57, during which they travelled, sometimes in company, sometimes separately, in the Deccan and in the region of the Himalayas, even prosecuting their investigations beyond the frontiers of the Company's territory into the region of the Karakorum and Kuenlun Mountains. Hermann and Robert were the first Europeans who crossed the latter mountains, and it was in honour of that achievement that the former had the title or sürname of Sakünlünski bestowed upon him (in 1864). The two returned to Europe in the summer of 1857, but Adolf, who remained to prosecute his explorations in Central Asia, was put to death by the emir of Kashgar on the 26th of August. Between 1860 and 1866 Hermann and Robert published in four volumes the "Results of a Scientific Mission to India and High Asia." The extensive collections of ethnography and natural history made by them were ultimately deposited in the Burg at Nuremberg through the intervention of the king of Bavaria (May 1877). Hermann spent the last years of his life chiefly in literary and scientific activity, partly at Munich partly at the castle of Jägernburg near Forchheim. He died at Munich on the 19th of January 1882.

His brother Robert was appointed professor of geography at Giessen in 1864, but his academical labours were sometimes interrupted by travels, especially in the United States, which furnished him with material for more or less important works. He died at Giessen, June 6, 1885. Of two other brothers, one, Edward (born March 23, 1831), killed in battle at Kissingen in 1866, made himself known by an account of the Spanish expedition to Morocco in 1859–60. Emil (born July 7, 1835) is the author of several learned works relating to India and Tibet

SCHLANGENBAD. See SCHWALBACH.

SCHLEGEL, AUGUST WILHELM VON (1767–1845), German poet, translator, and critic; was born on the 8th September 1767 at Hanover, where his father, J. Adolf Schlegel, was a pastor. He was educated at the Hanover gymnasium and at the university of Göttingen. Having spent some years as a tutor in the house of a banker at Amsterdam, he went to Jena, where he was made a professor, and received from the duke of Weimar the title of "Rath." Here he began his translation of Shakespeare, which was ultimately completed, under the superintendence of Tieck, by Tieck's daughter Dorothea and Count Baudissin. A revised edition of this rendering, which is considered one of the best poetical translations in the German language, has been issued by the German Shakespeare society. At Jena Schlegel contributed to Schiller's periodicals the *Horen* and the *Musenalmanach*; and with his brother Friedrich he conducted the *Athenæum*, which ranked among the most powerful organs of critical opinion in Germany. He also published a volume of poems, and carried on a rather bitter controversy with Kotzebue. At this time the two brothers were remarkable for the vigour and freshness of their ideas, and commanded respect as the leaders of the rising Romantic school. In 1802 Schlegel went to Berlin, where he delivered lectures on art and literature; and in the following year he issued *Ion*, a tragedy in the antique style, which gave rise to a suggestive discussion on the principles of dramatic poetry. About the same time appeared his *Spanish Theatre*, in which he presented admirable translations of five of Calderon's plays; and in another volume he gave translations of Spanish, Portuguese, and Italian lyrics. In 1807 he attracted much attention in France by an essay in the French language, in which he compared Racine with Euripides. His lectures on dramatic art and literature, which have been translated into most European languages, were delivered at Vienna in 1808. Meanwhile he had been travelling in France, Germany, Italy, and other countries with Madame de Staël, who owed to him many of the ideas which she embodied in her work, *De l'Allemagne*. In 1813 he acted as the secretary of the crown prince of Sweden, through whose influence the right of his family to noble rank was revived. Schlegel was made a professor at the university of Bonn in 1818, and during the remainder of his life he occupied himself chiefly with Oriental studies, although he continued to lecture on art and literature, and in 1828 he issued two volumes of critical writings. In 1823–30 he published the *Indische Bibliothek*; and as separate works appeared (1823) the *Bhagavad-Gîta* with a Latin translation, and (1829) the *Râmâjana*. Schlegel was twice married—first to a daughter of Prof. Michaelis of Göttingen, then to a daughter of Prof. Paulus of Heidelberg. Both wives separated from him soon after their marriage. He died at Bonn on the 12th May 1845. As an original poet Schlegel is unimportant, but as a poetical translator he has rarely been excelled, and in criticism he exercised a strong influence by the emphasis with which he marked the distinction between classical and romantic literature. By his study of Sanskrit he helped to prepare the way for the development of the science of language.

In 1846–47 Schlegel's German works were issued in twelve volumes by Böcking. There is also an edition of his *Œuvres, écrites en français*, and of his *Opuscula Latina*.

SCHLEGEL, JOHANN ELIAS (1718–1749), a German dramatic writer, was born at Meissen on the 28th January 1718. He was educated at Schulpforta and at the university of Leipsic. In 1743, having finished his studies, he became private secretary to his relative, Von Spener, the Saxon ambassador at the Danish court. Afterwards he was made professor extraordinary at the academy of Soröe, where he died on the 13th August 1749. Schlegel was a contributor to the *Bremischen Beiträge*, and for some time, while he was living in Denmark, he edited a weekly periodical, *Der Fremde*. He was also known as a writer of clever poetical epistles. Incomparably his best works, however, are his dramas, which did much to prepare the way for the dramatic achievements of Lessing, by whom his genius was warmly appreciated. He wrote two lively and well-constructed comedies, the *Triumph der guten Frauen* and the *Stumme Schönheit*, the latter in alexandrines, the former in prose. *Hermann* and *Kanut* (in alexandrines) are generally considered his best tragedies.

His works were edited after his death by his brother, J. H. Schlegel, who had a considerable reputation as a writer on Danish history. Another brother, J. Adolf Schlegel, an eminent preacher, and author of some volumes of verse, was the father of August Wilhelm and Friedrich von Schlegel.

SCHLEGEL, KARL WILHELM FRIEDRICH VON (1772–1829), known chiefly as an historian of literature, was the brother of August Wilhelm von Schlegel. He was born

at Hanover on the 10th March 1772. Having studied at Göttingen and Leipsic, he attracted some attention by a book on the *Griechen und Römer* (1797), which was praised by Heyne. This work was soon followed by his *Geschichte der Poesie der Griechen und Römer*. At Jena, where he lectured as a privat-docent at the university, he contributed to the *Athenæum* many striking critical articles, and a number of lyrical poems which were afterwards included in a volume entitled *Gedichte*. Here also he wrote *Lucinde*, an unfinished romance, which was held by some of the best of his contemporaries to be of a deeply immoral tendency, and *Alarcos*, a tragedy, in which he attempted without much success to combine romantic and classical elements. In 1802 he went to Paris, where he edited *Europa*, lectured on philosophy, and carried on Oriental studies, some results of which he embodied in a well-known book, *Ueber die Sprache und Weisheit der Indier*. In 1803 he and his wife joined the Roman Church, and from this time he became more and more opposed to the principles of political and religious freedom. He went to Vienna in 1808, and in the following year was engaged as imperial court secretary at the headquarters of the archduke Charles. At a later period he was for some time councillor of legation in the Austrian embassy at the Frankfort diet, but in 1818 he returned to Vienna. Meanwhile he had published two series of lectures, *Ueber die neuere Geschichte* (1811) and *Geschichte der alten und neuen Literatur* (1815). After his return to Vienna from Frankfort he edited *Concordia*, and began the issue of his *Sämmtliche Werke*. He also delivered lectures, which were republished in his *Philosophie des Lebens* (1828) and in his *Philosophie der Geschichte* (1829). He died on the 11th January 1829 at Dresden, where he was delivering the course of lectures which appeared in 1830 under the title *Philosophische Vorlesungen, insbesondere über die Philosophie der Sprache und des Wortes*. His own collection of his works included ten volumes, and to this number five volumes were added after his death. A permanent place in the history of German literature belongs to Friedrich Schlegel and his brother August Wilhelm as the critical leaders of the Romantic school, which derived from them most of its governing ideas as to the characteristics of the Middle Ages, and as to the methods of literary expression. In their writings, too, there is the fullest and most impressive statement of the mystical spiritual doctrines of the Romantic school. Of the two brothers, August Wilhelm did the highest permanent service to his countrymen by his translations from Shakespeare and Calderon. The best of Friedrich's works is his *Geschichte der alten und neuen Literatur*, in which was presented for the first time a systematic account of the development of European literature as a whole.

Friedrich Schlegel's wife, Dorothea, a daughter of Moses Mendelssohn, was born at Berlin about the year 1770, and died at Frankfort in 1839. She was an eccentric but remarkably clever woman, and wrote or edited several works, issued by her husband,—the unfinished romance *Florentin* (1801), the first volume of the *Sammlung romantischer Dichtungen des Mittelalters* (2 vols., 1804), and *Luther und Muller* (1805). By her first marriage she had a son, Philip Veit, who became one of the most eminent painters of his day in Germany.

SCHLEICHER, AUGUST (1821–1868), born at Meiningen on February 19, 1821, studied at the universities of Leipsic and Tübingen, became extraordinary professor of philology in Prague in 1850, removed to Jena as ordinary professor in 1857, and died there December 6, 1868. His work is characterized in the article PHILOLOGY, vol. xviii. p. 782.

SCHLEIDEN, MATTHIAS (1804–1881), was born at Hamburg in 1804. He studied law at Heidelberg and practised as advocate in Hamburg till 1831, but not succeeding he studied botany and medicine at Göttingen and Berlin, and graduated in Jena in 1839, where he afterwards became professor of botany (1846–50). In 1863 he was called to Dorpat, but resigned the following year and returned to Germany, where he lived as a private teacher. He died at Frankfurt in 1881. His title to remembrance is twofold. Uniting the labours of two centuries of workers in vegetable histology, from Malpighi and Grew to Mirbel and Robert Brown, he proved that a nucleated cell is the only original constituent of the plant embryo, and that the development of all vegetable tissues must be referred to such cells, thus preparing the way for the epoch-making cell theory of Schwann; and his *Principles of Scientific Botany*, which went through several editions (1842–50), did much to shake the tyranny of the purely systematic Linnean school, whose accumulations he was accustomed irreverently to describe as "hay." Despite a certain inability to criticize and verify his own hypotheses, he gave, both by his speculative activity and by the introduction of improved technical methods, so vivid an impulse to the younger botanists of his time as to have earned from De Bary the title of reformer of scientific botany. His botanical labours practically ceased after 1850, when he entered on various philosophical and historical studies. See SCHWANN.

SCHLEIERMACHER, FRIEDRICH DANIEL ERNST (1768–1834), theologian and philosopher, was the son of a Prussian army-chaplain of the Reformed confession, and was born November 21, 1768, at Breslau. In his fifteenth year the boy, who was of a weak constitution, was placed by his parents in a Moravian school at Niesky in Upper Lusatia, and two years later in the seminary of the same sect at Barby near Halle. Here Moravian theology proved inadequate to satisfy the deep religious needs and awakening intellect of the youth. It was particularly the doctrines of eternal punishment, of the deity and the substitutionary sufferings of Christ, and of the total corruption of human nature that were stumbling-blocks to him. He was also unable to make his own the peculiar religious experiences of his Moravian and pietistic teachers. The efforts of his strictly orthodox father and of the heads of the seminary to lead him to crush his doubts as sinful, and to shun modern theology and literature, tended only to strengthen his desire to explore the great world of knowledge. Reluctantly his father gave him permission to leave Barby for the university of Halle, and the correspondence between the father and the son on this painful crisis in Friedrich's life supplies a striking illustration of a typical phase of distressing modern mental history. When Schleiermacher entered the university of Halle (1787) the reign of pietism there had ceased, having given way to the rationalistic philosophy of Wolf with the critical theology of Semler, though the new philosophy of Kant was rapidly displacing Wolf's. As a student he pursued an independent course of reading and neglected to his permanent loss the study of the Old Testament and of the Oriental languages. But he frequented the lectures of Semler and of J. A. Eberhard, acquiring from the former the principles of an independent criticism of the New Testament and from the latter his love of Plato and Aristotle. At the same time he studied with great earnestness the writings of Kant and Jacobi. He commenced thus early his characteristic habit of forming his opinions by the process of patiently examining and weighing the positions of all thinkers and parties. But with the receptivity of a great eclectic he combined the reconstructive power of a profoundly original thinker. While yet a student he began to apply ideas gathered from the Greek philosophers in a reconstruction of Kant's system. At the completion

of his three years' course at Halle he obtained through the influence of the court-chaplain Sack an appointment as private tutor in the family of Count Dohna-Schlobitten, which he held upwards of two years, developing in a cultivated and aristocratic household his deep love of family and social life. After short engagements in tuition and as *locum tenens* to a clergyman of the small town of Landsberg, he received (1796) the appointment of chaplain to the Charité Hospital in Berlin, a position which he held nearly six years, and which offered no scope for the development of his powers as a preacher. He was the more induced to seek the satisfaction of his mental and spiritual necessities in the cultivated society of Berlin, and in profound philosophical studies. This was the period in which he was constructing the framework of his philosophical and religious system. It was the period too when he made himself widely acquainted with art, literature, science, and modern culture generally. He was at that time profoundly affected by German Romanticism, as represented by his friend Friedrich Schlegel, and it required all the energy of his moral nature and the force of his intellect to preserve himself from its moral and mental extravagances. Of this his *Confidential Letters* on Schlegel's *Lucinde* (1801), as well as his perilous relation to Eleonore Grunow, the wife of a Berlin clergyman, are proof and illustration. Gradually his sound moral nature, his deep religiousness, and his powerful intellect enabled him to emancipate himself entirely from the errors and weaknesses of a transient phase of mental and social history, and to appropriate at the same time the elements of truth and goodness which it possessed in rich measure. Romanticism unlocked for him the divine treasures of life and truth which are stored in the feelings and intuitions of the human soul, and thus enabled him to lay the foundations of his philosophy of religion and his ethical system. It enriched his imagination and life too with ideals ancient and modern, which gave elevation, depth, and colour to all his thought. Meantime he studied Spinoza and Plato, and was profoundly influenced by both, though he was never a Spinozist; he made Kant more and more his master, though he departed on fundamental points from him, and finally remodelled his philosophy; with some of Jacobi's positions he was in sympathy, and from Fichte and Schelling he accepted ideas, which in their place in his system, however, received another value and import. The literary fruit of this period of intense fermentation and of rapid development was his "epoch-making" book, *Reden über die Religion* (1799), and his "new year's gift" to the new century, the *Monologen* (1800). In the first book he vindicated for religion an eternal place amongst the divine mysteries of human nature, distinguished it from all current caricatures of it and allied phenomena, and described the perennial forms of its manifestation and life in men and society, giving thereby the programme of his subsequent theological system. In the *Monologen* he threw out his ethical manifesto, in which he proclaimed his ideas as to the freedom and independence of the spirit, and as to the relation of the mind to the world of sense and imperfect social organizations, and sketched his ideal of the future of the individual and society. In 1802, to his great advantage morally and intellectually, Schleiermacher exchanged the brilliant circle of Berlin Romanticists for the retired life of a pastor in the little Pomeranian town of Stolpe. Here he remained two years, which were full of pastoral and literary work, as well as rich in personal and moral progress. He relieved Friedrich Schlegel entirely of his nominal responsibility for the translation of Plato, which they had together undertaken, and regarded the completion of it as the work of his life. The first volume was published in 1804, and the last (the *Republic*) in 1828. At the same time another work, *Grundlinien einer Kritik der bisherigen Sittenlehre* (1803), the first of his strictly critical and philosophical productions, occupied him. This work is a severe criticism of all previous moral systems, especially those of Kant and Fichte, Plato's and Spinoza's finding most favour; its leading principles are that the tests of the soundness of a moral system are the completeness of its view of the laws and ends of human life as a whole and the harmonious arrangement of its subject-matter under one fundamental principle; and, though it is almost exclusively critical and negative, the book announces clearly the division and scope of moral science which Schleiermacher subsequently adopted, attaching prime importance to a "Güterlehre," or doctrine of the ends to be obtained by moral action. But the obscurity of the style of the book as well as its almost purely negative results proved fatal to its immediate success. In 1804 Schleiermacher removed as university preacher and professor of theology to Halle, where he remained until 1807, and where he quickly obtained a reputation as professor and preacher, and exercised a powerful influence in spite of the contradictory charges of his being an atheist, Spinozist, and pietist. In this period he wrote his dialogue the *Weihnachtsfeier* (1806), a charming production, which holds a place midway between his *Reden* and his great dogmatic work the *Christliche Glaube*, and presents in the persons of its speakers phases of his growing appreciation of Christianity as well as the conflicting elements of the theology of the period. After the battle of Jena he returned to Berlin (1807), was soon appointed pastor of the Trinity Church there, and the next year married the widow of his friend Willich. At the foundation of the Berlin university (1810), in which he took a prominent part, he was called to a theological chair, and soon became secretary to the Academy of Sciences. He was thus placed in a position suited to his powers and in domestic and social surroundings adapted to meet the wants of his rich nature. At the same time he approved himself in the pulpit and elsewhere as a large-hearted and fearless patriot in that time of national calamity and humiliation, acquiring a name and place in his country's annals with Arndt, Fichte, Stein, and Scharnhorst. He took a prominent part too in the reorganization of the Prussian church, and became the most powerful advocate of the union of the Lutheran and Reformed divisions of German Protestantism. The twenty-four years of his professional career in Berlin were opened with his short but important outline of theological study (*Kurze Darstellung des theologischen Studiums*, 1810), in which he sought to do for theology what he had done for religion in his *Reden*. While he preached every Sunday, he also gradually took up in his lectures in the university almost every branch of theology and philosophy—New Testament exegesis, introduction to and interpretation of the New Testament, ethics (both philosophic and Christian), dogmatic and practical theology, church history, history of philosophy, psychology, dialectics (logic and metaphysics), politics, pædagogy, and æsthetics. His own materials for these lectures and his students' notes and reports of them are the only form in which the larger proportion of his works exist,—a circumstance which has greatly increased the difficulty of getting a clear and harmonious view of fundamental portions of his philosophical and ethical system, while it has effectually deterred all but the most courageous and patient students from reading these posthumous collections. As a preacher he produced a powerful effect, yet not at all by the force of his oratory but by his intellectual strength, his devotional spirit, and the philosophical breadth and unity of his thought. In politics he was an earnest friend of

liberty and progress, and in the period of reaction which followed the overthrow of Napoleon he was charged by the Prussian Government with "demagogic agitation" in conjunction with the great patriot Arndt. At the same time he prepared for the press his chief theological work *Der christliche Glaube nach den Grundsätzen der evangelischen Kirche* (1821–22; 2d edition, greatly altered, 1830–31). The fundamental principle of this classical work is, that religious feeling, the sense of absolute dependence on God as communicated by Jesus Christ through the church, and not the creeds or the letter of Scripture or the rationalistic understanding, is the source and law of dogmatic theology. The work is therefore simply a description of the facts of religious feeling, or of the inner life of the soul in its relations to God, and these inward facts are looked at in the various stages of their development and presented in their systematic connexion. The aim of the work was to reform Protestant theology by means of the fundamental ideas of the *Reden*, to put an end to the unreason and superficiality of both supernaturalism and rationalism, and to deliver religion and theology from a relation of dependence on perpetually changing systems of philosophy. Though the work added to the reputation of its author, it naturally aroused the increased opposition of the theological schools it was intended to overthrow, and at the same time Schleiermacher's defence of the right of the church to frame its own liturgy in opposition to the arbitrary dictation of the monarch or his ministers brought upon him fresh troubles. He felt himself in Berlin more and more isolated, although his church and his lecture-room continued to be largely attended. But he prosecuted his translation of Plato and prepared a new and greatly altered edition of his *Christliche Glaube*, anticipating the latter in two letters to his friend Lücke (in the *Studien und Kritiken*, 1829), in which he defended with a masterly hand his theological position generally and his book in particular against opponents on the right and the left. The same year he lost his only son—a blow which, he said, "drove the nails into his own coffin." But he continued to defend his theological position against Hengstenberg's party on the one hand and the rationalists Von Cölln and D. Schulz on the other, protesting against both subscription to the ancient creeds and the imposition of a new rationalistic formulary. In the midst of such labours, and enjoying still full bodily and mental vigour, he was carried off after a few days' illness by inflammation of the lungs. He died thinking "the profoundest speculative ideas which were one with his deepest religious feeling," and partaking of the sacrament of the Lord's supper, February 12, 1834.

Schleiermacher's friend, the naturalist and poet Steffens, has left the following description of his appearance about the beginning of the century:—"Schleiermacher was of small stature, a little deformed, yet hardly enough to disfigure him; all his movements were animated, and his features in the highest degree expressive; a certain keenness in his glance produced perhaps a repellent effect; indeed, he appeared to see through every one; his face rather long, all his features sharply cut, the lips firmly closed, the chin projecting, the eyes animated and flashing, his look always serious, collected, and thoughtful."

Schleiermacher's Philosophical System.—A great antithesis lies at the basis of all thought and life—that of the real and the ideal, of organism, or sense, and intellect. But the antithesis is not absolute, for in life and being both elements are united—though without its presence life and thought would be impossible. In the actual world the antithesis appears as reason and nature, in each of which, however, there is a combination of its two elements—the ideal and the real,—the reason having a preponderance of the first and nature a preponderance of the second. At the basis of nature lies universal reason as its organizing principle, and when reason becomes a conscious power in man it finds itself in conflict as well as in harmony with external nature. The whole effort and end of human thought and action is the gradual reduction of the realm and the power of this antithesis in the individual, the race, and the world. Though the antithesis is real and deep, the human mind cannot admit its absolute nature; we are compelled to suppose a transcendental reality or entity in which the real and the ideal, being and thought, subject and object, are one. Consciousness itself involves the union of the antithetic elements, and prior to moral action nature is found organized and reason manifested or symbolized therein. We are ourselves proofs of the unity of the real and the ideal, of thought and being, for we are both, our self-consciousness supplying the expression of the fact. As we have in ourselves an instance of the identity of thought and being, we must suppose a universal identity of the ideal and real behind the antithesis which constitutes the world. This supposition is the basis of all knowledge, for thought becomes knowledge only when it corresponds to being. The supposition may be called a belief, but it is so only in the sense in which belief appears in the religious department, where it is the ultimate ground of all action. The supposition is the basis of all ethics, for without the conviction of the correspondence of thought and reality action would be fruitless and in the end impossible. It is above all the substance of religious feeling, which is the immediate consciousness of the unity of the world, of the absolute oneness behind the infinite multiplicity of contrasts; indeed, it is the religious conviction of the unity which is the best guarantee of the truth of the suppositions of philosophy. It is "the religious consciousness of the unity of the intellectual and physical world in God" which is to overcome the scepticism of the critical philosophy. But, though this unity must be laid down as the basis of knowledge, it is absolute and transcendental. In contrast with the "world," as the totality of being in its differentiation, this absolute unity, or God, in whom the real as manifold, and the spirit as one, find their unifying base, by its very nature is unphenomenal, indefinable, and inconceivable. The idea is outside the boundary of thought, though its necessary postulate, and it is no less inaccessible to religious feeling, though it is its life and soul. Neither member of the antithesis of the real and the ideal must be conceived as producing the other; they are both equally existent and equally constituent elements of the world; but in God they are one, and therefore the world must not be identified with Him. The world and God are distinct, but correlative, and neither can be conceived without the other. The world without God would be "chaos," and God without the world an empty "phantasm." But though God is transcendent and unknowable He is immanent in the world. In self-consciousness God is present as the basis of the unity of our nature in every transition from an act of knowledge to an act of will, and *vice versa*. As far as man is the unity of the real and the ideal, God is in him. He is also in all things, inasmuch as in everything the totality of the world and its transcendental basis is presupposed by virtue of their being and correlation. The unity of our personal life amidst the multiplicity of its functions is the symbol of God's immanence in the world, though we may not conceive of the Absolute as a person. The idea of the world as the totality of being is, like the correlative idea of God, only of regulative value; it is transcendent, as we never do more than make approaches to a knowledge of the sum of being. The one idea is the transcendental *terminus a quo* and the other the transcendental *terminus ad quem* of all knowledge. But though the world cannot be exhaustively known it can be known very extensively, and though the positive idea of God must always remain unattainable we are able to reject those ideas which involve a contradiction of the postulate of the Absolute. Thus the pantheistic and the theistic conceptions of God as the supreme power, as the first cause, as a person, are alike unallowable, since they all bring God within the sphere of antithesis and preclude His absolute unity. On the other hand, the world can be known as the realm of antithesis, and it is the correlative of God. Though He may not be conceived as the absolute cause of the world, the idea of absolute causality as symbolized in it may be taken as the best approximate expression of the contents of the religious consciousness. The unbroken connexion of cause and effect throughout the world becomes thus a manifestation of God. God is to be sought only in ourselves and in the world. He is completely immanent in the universe. It is impossible that His causality should have any other sphere than the world, which is the totality of being. "No God without a world, and no world without God." The divine omnipotence is quantitatively represented by the sum of the forces of nature, and qualitatively distinguished from them only as the unity of infinite causality from the multiplicity of its finite phenomena. Throughout the world—not excepting the realm of mind—absolute necessity prevails. As a whole the world is as good and perfect as a world could possibly be, and everything in it, as occupying its necessary place in the whole, is also good, evil being only the necessary limitation of individual being.

Schleiermacher's psychology takes as its basis the phenomenal dualism of the ego and the non-ego, and regards the life of man as