Selection of Meeting Sites

Well over 200 organizations across the country have joined the boycott of states that have not ratified the Equal Rights Amendment.

Even if the Council Policy Committee is reluctant to express social conscience by adding ASM to this list, I would like to suggest that all future meetings “accidentally” be scheduled only in ratified states, at least through 1982. That shouldn’t be too difficult, with 35 states to choose from.

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Poor Slides

Having just attended the last session of the 18th ICAAC Program in Atlanta, Ga., I would like to take this opportunity to thank the entire ASM Staff for their most astute choice of topics. I do not think that there has been a better program with more provocative issues and organized in such an intelligent fashion since I have been attending these sessions.

I would, however, leave you with some criticisms as to the mechanics of the meeting which I think detracted significantly from some of the presentation. I think it is an absolute insult to the audience for a speaker at a national meeting to show slides that are homemade and of such poor quality that they not only impair the effectiveness of the presentation but have caused, in a significant number of instances, to have the spectators leave the sessions because the slides were unintelligible.

I believe that, in a meeting of such stature, any pictorial data should be displayed in a form that can be viewed at least from the middle of the seated audience and not just seen by the first and second rows.

Such poor planning might be excused if the presenters were students, but most, if not all, of the presenters were at least at the doctoral or postdoctoral level.

I am certain that mine may be one of the first, but certainly not the last, critique that you will be receiving regarding this aspect. I certainly hope that for the 19th ICAAC Program this problem will be nonexistent.

Bacteria as the Cause of Disease in Plants: A Historical Perspective

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A number of plant pathologists have designated T. J. Burrill, Professor at the University of Illinois, as the scientist who first outlined creditable proof that bacteria could cause plant disease. Since this investigator presented his evidence in 1878, before development of pure culture methods and Koch's rules of proof, one can justifiably ask what constitutes “evidence” or “proof” that bacteria cause disease in plants. How much evidence would be necessary to establish cause and effect at such a time in history? Who would have the authority to make final judgment on the quality of the proof?

Discovery is often determined by time and circumstances. Fire blight disease of pear, apple, and quince had been known since colonial times and was historically an “American” disease. By 1863 and again in 1869, the Illinois State Horticultural Society had taken a ballot vote to summarize opinions on the cause of fire blight. All sorts of causes had been named; perhaps the real cause was particularly ripe for discovery at the time in view of the fact that bacteria had already been implicated in disease of animals and man.

In the summary which follows, we will consider some pertinent evidence concerning proof of the bacterial nature of fire blight and certain other plant diseases. It is a timely topic for us to share with colleagues in microbiology. We have gathered information from original publications, translations of originals, and communications from our contemporaries; we will
provide a number of quotations from these sources, attempting to be as brief as possible while faithfully adhering to the context.

At least three investigators should be considered in the historical concept of bacteria as plant pathogens.

The first investigator to consider is **Mitscherlich**. According to Thimann (19), 1850 is considered in a list of important dates relating to microbiology. This author gives credit to Mitscherlich, a German chemist, for being the first investigator to discover that bacteria could cause disease in plants. Reporting to the Imperial Academy of Science in Berlin in 1850, Mitscherlich published his observations on “active liquid” that degraded potato tuber cell walls. He went on to report the content of cellulose in tuber cell walls and to describe progressive degradation of slices of potato tuber in the presence of bacteria. He attributed this action to vibrios (*Vibrio* was considered to be one of the six genera of bacteria at the time) and concluded that no trace of fungi could be found in the decaying tissues. Mitscherlich did not produce further work on this topic, although he expressed hope of doing so.

The second investigator, T. J. **Burrill**, in his treatise of the so-called “fireblight” of pear trees in 1878 (8) stated that “so far as I know the idea is an entirely new one—that bacteria cause disease in plants—though abundantly proved in the case of animals.” Burrill was aware of the work by Mitscherlich, and upon analysis, he translated the German noun “Vibrionen” to mean “living atom.” Had Burrill translated the term “Vibrionen” to mean “motive bacteria of the genus *Vibrio*” it is possible that Mitscherlich would have become more prominently recognized by plant pathologists for his contributions.

Considerable early transmission work with fire blight preceded that of Burrill (5). Several farmers speculated on the causal entity, and in 1845, Gookins reported that one Ruben Ragan made the following description of the results on transmission experiments:

> We found the leaves of the patient changing color, and emitting that peculiar odor which . . . is always present in cases of blight, and upon applying the knife, the inner bark was found to be black from the root to the top while nothing of the kind appeared elsewhere in the nursery. . . . The atmosphere is, I believe, generally admitted to be the medium by which they (epidemics) prevail, and are carried from place to place. What that subtle principle may be . . . by which infection is retained and transmitted . . . human science has not discovered . . . but that such a principle exists, is sufficiently obvious in its effects.

In Burrill’s home state of Illinois, E. S. Hull of the State Horticultural Society reported in 1870 that he was able to transmit the disease to at least three hosts.

In Burrill’s first paper on fire blight in 1877 (7) he reported that “the sap of the newly blightened limbs, especially in the young cells between wood and the bark, swarm with minute living particles, visible only with the high powers of the microscope . . . resembling the spermatia of fungi and lichens. . . .” In his second paper in 1878 (8), he remarked that “no one has yet positively traced what this connection is” (the connection with the fungi). “There is evidence that the theory of the fungus origin of the fire blight of pear and the common twig blight of apple, is well founded.” However, before the Illinois State Horticultural Society that same year, **Burrill** said:

> the so-called fire blight of the pear and the common twig blight of apple are almost surely due to the same cause. If one removed the bark of a newly infected limb and placed a little of the mucilaginous fluid from the brown tissue under a microscope, the field is seen to be alive with moving atoms known in a general way as bacteria. . . . A particle of this viscous fluid introduced upon the point of a knife into the bark of a healthy tree is in many cases followed by blight of the part, but with me not in every instance . . . the disease spreads more or less rapidly from the point of origin, and upon examination the moving microscopic things are discovered in advance of the discolored portions of the tissue. . . . Does it not seem plausible that they cause the subsequent apparent change? It does to me, but this is the extent of my own faith; we should not say the conclusion is reached that the cause of the difficulty is definitely ascertained. So far as I know the idea is an entirely new one—that bacteria cause disease in plants . . . The so-called germ theory of disease in animals . . . is rapidly gaining support and credence. Is it not possible that we are now making a beginning of the applications of the theory to the disease in plants . . . ? (8)

By 1880 **Burrill** demonstrated that fire blight of pear, twig blight and trunk *suncsai* of apple, and blight of quince were variants of the same malady. Burrill also described the bacteria, by use of his 1,000-power microscope and estimated their dimensions to be 1 × 1.5 μm and motile; they were crudely illustrated.

> “There is absolutely no trace of other fungus growth in the tissues . . . until after death has taken place. . . .” He also observed exudate dried on diseased twigs (9, 10).

In 1882 **Burrill** was convinced that his hypothesis was correct, and named the causal
bacterium *Micrococcus amylovorus*. His brief description was included, with a comment: "the cause of 'blight' in plants, especially of the pear tree and of the apple tree . . . gains entrance to living tissues through wounds or punctures. . . . The disease is transmissible by artificial inoculation" (11). In 1883 Burrill further stated (12):

There seems to have been no attempt to disprove the conclusions published in our transactions for 1880, nor has there been any evidence that anything besides bacteria does this deadly work in the tissues of our pear trees. That a certain and now well-known species of the minute organisms popularly known as bacteria is the real, active and immediate cause of this blight, is a fixed and positive fact—not a fancy nor a theory; a demonstrated and demonstrable truth—not a conjecture . . . beyond this confident assertion of the fact I do not now care to go.

It should be pointed out that a number of other investigators were studying bacterial maladies of plants at the time of Burrill's work.

F. M. Dränert reported on studies of sugar cane disease, in which he observed bacteria flowing from cut stalks: "From such cane the yellow material was collected, which, dissolved in water, appears as a micrococcus." This work was reported in 1869. Also, Woronin (1866) had demonstrated, microscopically, the presence of bacteria in root nodules of lupin. The so-called "rose-red" disease of wheat was studied by Prillieux, and in 1879 this worker reported finding abundant bacteria in cavities of the seeds. He did not, however, produce pure cultures or inoculations, and there has been no confirmation of his work. In 1880, Comes recognized bacteria in many plant diseases but, again, did not use pure cultures and made no inoculations. The organisms he observed are not identifiable from his descriptions (5). In Holland, Wakker published many articles on hyacinth yellows and transferred inoculum directly from diseased plants to healthy ones; his first successful inoculations were inoculated into pear trees, but Arthur was never able to reproduce the disease from this source. If he mixed blight bacteria with other types of bacteria, "the resulting blight contained but one sort" of bacteria. He thus concluded that a specific bacterium acted alone in producing fire blight.

Arthur went on to try a variety of media for growing the bacteria causing fire blight and concluded that these "germs" probably would thrive on decaying vegetable matter for possibly a year or two, be blown around by the wind with some coming to rest on expanding shoots or flowers, and cause infection of the tree. Bacteria from various rotting plant tissues were inoculated into pear trees, but Arthur was never able to reproduce the disease from this source. If he mixed blight bacteria with other types of bacteria, "the resulting blight contained but one sort" of bacteria. He thus concluded that a specific bacterium acted alone in producing fire blight.

Arthur presented these studies to Cornell as a Ph.D. thesis in 1886, and this is recorded as the first Ph.D. degree conferred in the field of science from Cornell University. In his enthusiastic pursuit of bacterial plant pathology, Arthur and a student described a so-called bacterial disease of sugar beet (4) that later turned out to be caused by a virus; he and a colleague also described a leaf spot of carnation (3), thought to be caused by a bacterium, but later others proved it to be due to insect (aphid) feeding.
Perspectives. Perhaps it is the wrong approach to assign credit too generously to any one person in a field where many have added to our knowledge of bacterial plant pathology. The historical setting is, of course, vital to interpreting value of any of the works. It is appropriate, however, to cover briefly the probable reasons for emphasis on Burrill and the date 1878.

By the turn of the century a scientist named Erwin F. Smith had gained world acclaim as an authority on bacterial diseases of plants and shortly thereafter published a number of books on the topic. Smith frequently commented on the contributions of Burrill and Arthur and stated that Professor Burrill proved four things conclusively: (1) the absence of any fungus in the blighting pear twigs; (2) the constant presence of the motile bacillus in enormous numbers in freshly blighted twigs; this bacillus, moreover, could always be found pushing into the sound tissue some centimeters in advance of the visible browning and death; (3) the infectious nature of the freshly blighted material; and (4) the identity of the blight on pear, apple, and quince. While admitting that J. C. Arthur finally settled the point on pure culture methods, Smith stated in 1916 (18) “just as Pasteur’s contribution to science is more vital than Koch’s, because it was earlier and was pioneer work, so Burrill’s discovery was more difficult to make and hence more worthy of praise than anything that has come after.”

The influence of Smith apparently was so great that his evaluation and statements about Burrill were uncritically accepted by the authors of many textbooks, and in this fashion Burrill has been given credit by many for the discovery that bacteria can cause disease in plants. It is a mystery why Burrill (13), in reporting a “pure culture” of bacteria when dealing with corn and sorghum, did not try this technique on isolation of bacteria from blighted pear and apple. We must assume that he knew about the new method but apparently chose not to try it on fire blight disease. A careful reading of Burrill’s papers gives us the impression that from 1877 to 1882 he became increasingly convinced of the correctness of his hypothesis, but this confidence seems to have been based more on lack of effective dissent from others and on pride in a comfortably familiar idea than on continuing intensive study. Later a student of Burrill (6) said “while this result was all but convincing, Burrill fully recognized the incompleteness of his proof. To J. C. Arthur it was left to furnish the connecting link of proof as to the bacterial nature of the disease.” J. C. Arthur stated (1):

The priority of demonstrating parasitic bacteria in plants belongs to an American. In 1880, two years before Dr. Wakker’s announcement of bacteria in hyacinth, Professor T. J. Burrill of Illinois presented a paper . . . demonstrating the invariable presence of characteristic bacteria-in pear blight-and that the disease may be transmitted from tree to tree in inoculation. Since then the bacteria have been isolated and cultivated in artificial media, and the statement of the original paper fully confirmed.

We are tempted to conclude that Burrill’s place in history with respect to these studies is perhaps based on the fact that he was proved by others to have been right, and that he had a strong advocate in Erwin F. Smith. Certainly development of the concept that bacteria were primary causes of disease in plants was gradual and, as in nearly all advancements in science, many made valuable contributions. For a more exhaustive treatise, the reader is referred to Baker (5).

The role of bacteria as causal agents of plant disease was meticulously studied after the turn of the century, and today they rate high in the list of destructive pathogens of economic plants. The importance of mycoplasmas, spiroplasmas, and rickettsiae have been added in the last decade. Humans continue to be a critical factor in the success of the entire group of “bacterial” plant pathogens, and their pursuit of knowledge relating to the taxonomy, ecology, and physiology of these pathogens continues at an ever-increasing pace.

LITERATURE CITED


INTERNATIONAL SCENE

US-USSR Cooperation on Production of Substances by Microbiological Means

The US-USSR Joint Working Group for Scientific and Technical Cooperation on Production of Substances by Microbiological Means has renewed the agreement for an additional 5 years. Planning is presently underway on restructuring of possible joint tasks for cooperation in Science and Technology. Activities in the past have been carried out under two projects of the Working Group, and they are as follows:


The coordinators would like to invite members of the American scientific community to submit their ideas for specific areas of joint research and cooperation and to identify Soviet institutes and scientists who might participate in this cooperation. Please reply by 15 March 1979 to: Dr. Arthur E. Humphrey, University of Pennsylvania, 107 Towne Bldg. D3, Philadelphia, PA 19104.

Fourth US-USSR Enzyme Conference Held in New Orleans

The US-USSR Joint Working Group on the Production of Substances by Microbiological Means held its Fourth Microbial Enzyme Reactions Conference on 30 October–2 November 1978, at the Marriott Hotel in New Orleans, La. Thirty-two scientific papers on new enzyme sources for industrial, medical, energy, and photographic uses were presented by 6 Soviet and 20 U.S. scientists.

The Microbiology Working Group is one of 11 such groups currently active under the US-USSR Agreement on Cooperation in Science and Technology, signed in 1972 and renewed last year. The overall program, designed to encourage scientific exchange and collaborative research, is sponsored by the National Science Foundation and administered under a contract by the ASM.

Proceedings of the conference will be published some time next year by the National Technical Information Service, U.S. Department of Commerce.