

We are thus brought to the question of the dimensions of the universe: what is the length of the complete straight line, the circuit of all space? The answer must be furnished by astrophysical observations, interpreted by a proposition which belongs to the theory of De Sitter's world, namely, that the lines of the spectrum of a very distant star should be systematically displaced; the amount of displacement is proportional to the ratio of the distance of the star from the observer to the constant radius of curvature  $R$  of the universe. In attempting to obtain the value of  $R$  from this formula we meet with many difficulties: the effect is entangled with the ordinary Doppler effect due to the radial velocity of the star; it could in any case only be of appreciable magnitude with the most distant objects; and there is the most serious difference of opinion among astronomers as to what the distance of these objects really is. Within the last twelve months the distance of the spiral nebula M 33 Trianguli has been estimated by Dr. Hubble, of the Mount Wilson Observatory, at 857,000 light-years, and by Dr. Perrine, the director of the Cordoba Observatory, at only 30,000 light-years; and there is a similar uncertainty of many thousands per cent. in regard to all other very remote objects. Under these circumstances we hesitate to assign a definite length for the radius of curvature of the universe; but it is millions of light-years, though probably not greater than about a hundred millions. The curvature of space at any particular place due to the general curvature of the universe is therefore quite small compared to the curvature which may be imposed on it locally by the presence of energy. By a strong magnetic field we can produce a curvature with a radius of only 100 light-years, and of course in the presence of matter the curvature is far stronger still. So the universe is like the earth, on which the local curvature of hills and valleys is far greater than the general curvature of the terrestrial globe.

In concluding these remarks I ought perhaps to apologize for having said nothing about the relation of general relativity to the new wave-mechanics. My excuse must be that, at the request of the secretary of the British Association, this address was sent to the printer many weeks before the meeting; and the wave-mechanics is developing so rapidly that, as one eminent worker has declared, anything printed is *ipso facto* out of date.

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#### CHARLES FULLER BAKER—A SKETCH

CHARLES FULLER BAKER, scientist, collector and pioneer, is dead—conquered on the very eve of the release which his indomitable will had long promised a harassed body. The doctors scarcely said whether it

was malignant malaria or amoebic dysentery or tuberculosis to which he succumbed at last.

Five or six years ago, when I knew him as well as most men ever came to know him, Baker was living in a bamboo "bahai" on the outskirts of the dank little village of Los Baños, forty miles south of Manila.

There, in his two rooms among the tops of palm trees, with the stench of his neighbors' pigs and carabaos floating up through the cracks in his floor, he made additions to his superb collections of insects and fungi, and "thanked the Lord daily" for the ships which brought him letters from scores of unseen, unknown friends who had come to know and revere his solitary work as a scientist.

Though he was then only a little over fifty years, fever and a hundred tropic diseases had wasted his body and parched his skin, so that he looked more than seventy—very white of hair and intense of eye.

Baker lived apart from the faculty of the College of Agriculture of which he was dean. Between him and most of us was an intangible though not unfriendly something which kept him from knowing the men intimately. Perhaps he found some compensation in the pioneer conditions, which, under earlier Wisconsin skies, had stirred the blood of his father, living there among the natives, cared for only by a Japanese servant and his wife, cooling his water in a swinging earthen jar and writing his innumerable letters.

At any rate, few persons knew when intense pain made agony of his nights, or whether despair ever killed the stoic courage in his eyes. Once, when I learned he was suffering from one of his recurrent attacks, I climbed the ladder-stairs of his shack and entered the gloom of his large single room. He was lying on a narrow rattan couch, very wizened, very pale, and yet very fierce in the still, dark heat.

"Buenos Dios, señor," he greeted me gaily, without moving. I urged him to let us care for him, but it was obvious that that day at least he could not be moved.

The next noon he sent a note:

"You are placing before me a fine temptation to be sick. . . . You probably don't know that you are also tempting me to go back on one of my most cherished principles, not to give up, or to resign myself to conditions until the Angel Gabriel blows his horn."

After a week he was up once more, riding behind the gray nag along the blazing three miles of road to the college, and greeting natives and Americans alike with his sweeping, faintly mocking friendliness.

Baker virtually built the Philippine College of Agriculture. He fought for the appropriations which kept it going; he sought eagerly for a faculty fired by a kindred zeal to his own, for using the tropics as a great laboratory in which to enrich human knowledge.

A work fraught *ab initio* with disappointment! A quest implicit with futility! Baker found few men so free of ambition for personal glory, so urged by passionate scientific curiosity, that they would suffer his exile unmindful of loneliness, disease, perilous trips, neither seeking nor expecting gratitude, wealth or even academic recognition.

Next to the college he organized, to which come native lads from every part of the islands (Baker could capture their imaginations and stir their hopes as no other member of the faculty could, or bothered to do), Baker was interested chiefly in his entomological and mycological collections.

He had a surpassing knowledge of insects and fungi and he showered the laboratories of collectors in the Orient and Europe with his specimens. His own collections he gave in part to the College of Agriculture of the University of the Philippines, to the University of Hawaii and to the Smithsonian Institute in Washington, D. C.

Impressive monuments though they are to his intrepid, tireless spirit, the generations whose knowledge and whose living will be richer because of them, can scarcely glean from them a sense of the heroism of this rare and daring personality.

Yet Baker was not coldly impersonal. In strange contradiction to his own stoicism, he was generous and sympathetic with people whose difficulties were not a fraction so severe as his own.

Once he gave up a long-cherished plan for a trip to another more remote part of the islands, because a native boy who was dying of tuberculosis had neither money nor friends to care for him. Baker took the money he had put aside for the trip and sent the lad to the mountains. For his own part, he stayed in his shack and classified his treasured insects.

In his death, science has lost a worker whose invaluable contributions were all too obscured by his indifference to public recognition, and a host of scattered admirers must be reminded of his countless kindnesses.

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## SCIENTIFIC EVENTS

### INTERNATIONAL ELECTRICAL CONGRESSES

THE Electrical Division of the Bureau of Standards has announced that it is represented at two international electrical conferences to be held in Italy this month. The International Electrotechnical Commission meeting will be attended by the Assistant Chief of the Electrical Division, Dr. J. Franklin Meyer, and Dr. J. H. Dellinger. Dr. Meyer will also attend the meeting of the International Commission on Illumination.

The sessions of the Electrotechnical Commission, the Bureau announced orally, were held at Bellagio on Lake Como from September 5 to September 13, with a special trip to Como on September 11, when the centenary of the death of Volta was commemorated in conjunction with the International Congress of Physics. After the technical sessions at Bellagio, the delegates to the meeting made a 10-day tour to various power plants and industrial establishments in Italy, ending at Rome, where a final meeting was held for formal acceptance of the results of the Commission meetings.

According to the preliminary program which has just been issued for the meeting, the Commission dealt with the standardization of electrical machinery and related problems, such as prime movers (steam engines and water turbines). During the meetings at Bellagio, consideration was given to specifications for such prime movers for switches, measuring instruments, insulating oils, lamp bases and holders, traction motors and radio electron tubes. There was also a discussion of the methods of rating the power of electrical machinery, of rating rivers in connection with water-power development, and of an international technical vocabulary covering the field of work of the Commission.

In addition to the government representatives mentioned, the sessions were attended by prominent engineers and executives, including representatives of the General Electric Company, the Westinghouse Electric & Manufacturing Company, the Edison Electric Illuminating of Boston, the New York Edison Company, the Electrical Testing Laboratories and a number of universities.

The International Commission on Illumination, which met at Bellagio from August 31 to September 3, included national committees in Great Britain, France, Italy, Germany, Belgium, Switzerland and Japan, in addition to the United States. Its work included the unification of practice in making photometric tests, the establishment of standard technical vocabularies, and in general the furtherance of good practice in lighting in the several countries.

The Bellagio meeting considered several technical problems—a primary standard of light, standard methods of comparing lights of different colors and the investigation of glare. Other matters dealing more directly with practice include proposed specifications for electric lamps, for street lighting and for the regulation of automobile headlights. There was also some general discussion of the teaching of the science and art of illumination and of the activities of lamp manufacturers in Europe and in America looking toward the improvement of illumination.

In accordance with the action taken at the last