CO concentrations and, consequently, leaf N would necessitate an even greater L. Rice cultivars before the green revolution did not achieve an L as great as 7.

An assumed major benefit of erect leaves in light capture for photosynthesis is not supported by either experimental or theoretical evidence (*4*). We propose, however, that erect leaves are required in order to sustain the high L needed to store N. Leaf senescence is induced when light reaching leaves is less than about 5% of incident sunlight (*5*). The following exponential equation for light interception (*6*) is a concise relation between light level and L

$$I/I_0 = \exp(-GL/\sin(S))$$

where I/I_0 is the ratio between light levels in and above the canopy; G is the shadow projection of leaves, which is dependent on leaf and sun angles; and S is the sun angle above horizontal. The value of G must be decreased to obtain high L exposed to $I/I_0 \geq 0.05$.

If one assumes that S is 70° and a pre–green revolution leaf angle is 45° (G = 0.664), the viable L for N storage is calculated to be 4.2. An L of 4.2 provides N to support a rice yield of about 6 tons per hectare. Higher yields demand a higher L for N storage, and this requires more erect leaves, as illustrated in Fig. 1. In studying the changes in rice varieties with year of release from the beginning of this century in Japan, Tanaka *et al.* (*7*) noted a progression toward higher yields associated with more erect leaves and higher L. We conclude that high N storage in leaves is essential for high yields of rice and that erect leaves are a necessary adaption to allow a high L for N storage.

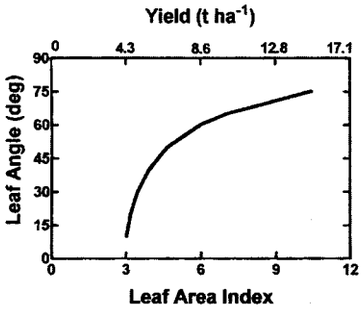

Fig. 1. Leaf angle above horizontal required in rice for adequate light penetration to achieve the leaf area indices and yields indicated on the abscissa. This plot assumes a sun angle of 70°.

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Einstein's "Kyoto Lecture": The Michelson-Morley Experiment

In the summer of 1996, I was asked by the editors of the Einstein Papers Project at Boston University to help prepare a new translation into English of a lecture by Einstein given at the Imperial University of Kyoto on 14 December 1922. The only source for this "Kyoto lecture" is a Japanese text (*1*) published by Jun Ishiwara (1881–1947) on the basis of notes, which have not been found, that he had taken during the lecture in order to be able to summarize its contents afterward for the Japanese audience. English translations of (parts of) this text were published by T. Ogawa (*2*) and Y. A. Ono (*3*). These have been cited as evidence that Einstein knew about the Michelson-Morley experiment much earlier than is usually thought. Much to my surprise, I discovered that these translations are unreliable in places, including the crucial passages dealing with the Michelson-Morley experiment. What Einstein really said, according to Ishiwara, is the opposite of what he is believed to have said on the basis of the existing translations.

Ishiwara was one of the earliest theoretical physicists in Japan and published several papers in first-rate journals (*4*). He studied abroad from 1912 to 1914 in Munich, Zurich, and Berlin under the direction of, among others, Arnold Sommerfeld and Max von Laue. He met Einstein in Zurich and Berlin. Because of the outbreak of the First World War, he returned to Japan and became a full professor at Tohoku University. During Einstein's stay in Japan, Ishiwara accompanied him almost everywhere. The following year he published his reconstruction of several of these lectures in Japanese.

The Kyoto lecture includes an account of Einstein's knowledge of the Michelson-Morley experiment, or, as Einstein apparently routinely referred to it "Michelson's experiment." He said that in his student days he made a plan to devise an experiment to demonstrate the relative motion of the Earth with respect to the ether. He hoped to detect an energy difference between a light beam

traveling in the direction of motion and a light beam traveling in the opposite direction by measuring the heat they would generate in a thermoelectric pile. Einstein then remarked that this experiment was similar to Michelson's experiment. Compare the translations of the next sentence by Ogawa and Ono, respectively, with mine.

"I had not carried out the experiment yet to obtain any definite result" (*2*, p. 79).

"I did not put this experiment to the test" (*3*, p. 461).

"I did not yet know this experiment well enough" (my translation).

Note that both Ogawa and Ono assume that Einstein is referring to the experiment that he himself was planning. A more natural reading of the Japanese text, however, is that Einstein is referring to "Michelson's experiment," mentioned at the end of the preceeding sentence. The Japanese text does not say that he "had not carried out" the experiment or that he "did not put to the test," but rather that he did not know about it. The phrase that seems to have caused misunderstanding was likely "klar machen" ("make clear" in German). Immediately following this sentence, Einstein, according to Ishiwara, said (and once again compare the translations),

"When I had these thoughts in my mind, still as a student, I got acquainted with the unaccountable result of the Michelson experiment, and then realized intuitively that it might be our incorrect thinking to take account of the motion of the earth relative to the aether, if we recognize the experimental result as a fact" (*2*, p. 79).

"While I was thinking of this problem in my student days, I came to know the strange result of Michelson's experiment. Soon I came to the conclusion that our idea about the motion of the Earth with respect to the ether is incorrect, if we admit Michelson's null result as a fact" (*3*, p. 46).

"But when, still as a student, I had these thoughts in my mind, if I had known the strange result of this Michelson's experiment and I had acknowledged it as a fact, I probably would have come to realize it intuitively as our mistake to think of the motion of the Earth against the ether" (my translation).

The problem is that Ogawa and Ono do not appear to have taken into account the possibility of a grammatical subjunctive past perfect in the phrase, "if I had known...." What Einstein said, if one assumes that Ishiwara's reconstruction is reliable, is that, as a student, he did, in fact, *not* know the result of the Michelson-Morley experiment. The statement about the Michelson-Morley experiment in the Kyoto lecture then ceases to be anomalous and fits with Einstein's other statements about this topic.

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4. Ishiwara published papers, mainly about the relativity theory and the heat radiation, in, for example, *Phys. Z.* [**13**, 1142 (1912)] and *Ann. Phys.* [**42**, 986 (1913)].
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Arsenic and Drinking Water Contamination

In India, several 100,000 persons are chronically exposed to tube-well water contaminated with arsenic. Besides, drinking water contamination with arsenic is known in some South American and other countries. As described (J. Kaiser, News &