named Le Fevre, about whom little is known. None of the professors of mathematics in our early universities can be compared favorably with the best of their contemporaries in Europe holding similar positions up to the latter half of the nineteenth century, when B. Peirce, of Harvard, began to make valuable contributions to the advancement of our subject.

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SCIENTIFIC LITERATURE

PROFESSOR VISSCHER'S article in SCIENCE of September 14 (p. 245) describes a difficult situation, but I think there are serious objections to his proposed remedy. I venture to call attention to a case in which it seems to me that the library difficulty has been fairly overcome. Economic entomology has in modern times developed to an enormous extent and has become exceedingly diversified. Works relating to it continually appear in many countries, in all sorts of languages, many for instance in Russian. If some agency would bring all these books and papers promptly to my desk on publication, I could not find time to read them, and in many cases, owing to the language, I could not read them at all. Many, perhaps most, are primarily intended for use in particular regions, or by particular classes of people, yet they usually contain something of broader interest. Now the Imperial Institute of Entomology, in London, produces monthly the *Review of Applied Entomology,* in two series, A. Agricultural, B. Medical and Veterinary. It is strictly up to date; thus I find the August, 1934, issue contains abstracts of articles received during June and July of the same year. The reviews or abstracts are sufficiently full to give an excellent idea of the work done, and usually include most of the matter of general interest. I have not rarely had the experience of reading an article, and not fully appreciating its significance until I read the abstract in the *Review.* In about two hours, each month, I am able to run over the whole field of current economic entomology, and note the matters which are of particular interest to me. Frequently I note discussions of broad biological interest, such as those on the carrying of insects by air currents, or those on the diverse forms of malaria mosquitoes. The cost is negligible; the price is to be raised next year, but even then it will be less than a dollar a month. The two prime features are (1) promptness and (2) well-written and sufficiently full reviews by people who know the subject.

When we consider how and why money is expended in this country, it seems ridiculous to complain about the cost of printing scientific papers. Institutions can send out costly expeditions, and yet declare they can not afford to pay for printing the results of the work of their staff. One of the best known and most highly esteemed scientific explorers in this country told me that he found it comparatively easy to raise money for an expedition, almost impossible to get it for publication, which is after all the result and purpose of the expedition. The whole situation depends on a wrong mental attitude and not on any real lack of power to accomplish what ought to be done. The lamentable consequence is that competent men will not spend their best years doing work of a comprehensive or fundamental character, not knowing how or whether it can be printed. I recently heard the story of one of the best entomological works produced in this country during the present century. The author had to put up $10,000 to get it published. Fortunately, the sales have been sufficient to repay the money, I presume without interest. But how many of us can afford to provide such a subsidy? The actual work on the book over many years brings of course no financial reward, nor was it expected to do so. Is it not conceivable that a more enlightened day will come when such an author will be considered a great public benefactor and will be relieved of all financial anxiety concerning publication?

Returning briefly to the problem of the reader and the library, what we especially need are good synopses which bring out the salient known facts and serve to guide the reader to the detailed literature. As examples of this type of work I think especially of two which have been published very lately. One is "The Classification of Insects: a Key to the Known Families of Insects and Other Terrestrial Arthropods," by C. T. Brues and A. L. Melander, published by the Museum of Comparative Zoology, Harvard, 1932. The other is "The Families and Genera of North American Diptera," by C. H. Curran, 1934. As time-savers and preventers of error, such works can hardly be overestimated, although, in the nature of things, they can not attain perfection. They enable the worker to review the field of his science and stimulate him to search for new facts which will add to or correct the record.

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PHOTODYNAMIC ACTION OF METHYLENE BLUE ON PLANT VIRUSES

PERDRAU and Todd,[1] studying the photodynamic action of methylene blue on nine animal viruses and on several strains of bacteriophage, found that the viruses of vaccinia, herpes, fowl-plague, louping-ill, Borna disease, Fujinami's tumor and canine distemper, as they exist in filtrates or other fluids devoid of

[1] *Proc. Roy. Soc.,* B, Vol. 112, pp. 277 to 287 and 288 to 297.

living cells, as well as several bacteriophages, were highly sensitive to the photodynamic action of methylene blue. When exposed to suitable illumination a concentration of 1 part in 100,000 of dye in contact with the virus inactivated each of these viruses within a few minutes. The viruses of foot-and-mouth disease and of infectious ectromelia were found to be more resistant but could be inactivated by increasing the intensity of the illumination.

Since no similar studies have been reported for plant viruses, the following experiments, details of which will be reported later, may be of interest.

In the main the technique of Perdrau and Todd was used for studying Wingard's ringspot, streak (single virus streak of tomato), Tobacco Virus 1 (Johnson) and Tobacco Virus 6 (Johnson)—also known as aucuba mosaic virus. Ten cc of the virus-dye mixtures at pH's of 5.8 to 6.0 were exposed in petri dishes to a 500 watt lamp at a distance of 26 inches. At various intervals 0.10 cc of the virus-dye mixtures were removed and used to inoculate test plants.

As judged by infectivity tests on tobacco and cucumber, ringspot virus was completely inactivated after two minutes' exposure. After 20 minutes' exposure the virus of streak was not inactivated, though the number of local lesions produced on *N. glutinosa* showed that the concentration had been slightly reduced. Tobacco Virus 1 and 6 showed no reduction in concentration, even after an exposure of one hour.

Tobacco Virus 6 (Johnson) was also exposed at pH's of 3.0, 7.0 and 8.0 to thionine, potassium indigodisulfonate and phenol-indo-phenol. The virus concentration as evidenced by the number of local lesions produced on *N. glutinosa* showed no apparent reduction as a result of this treatment.

From these experiments it would seem that in general plant viruses are more resistant to the photodynamic action of dyes than are animal viruses or bacteriophage.

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SCIENTIFIC BOOKS

RELATIVITY, THERMODYNAMICS AND COSMOLOGY

Relativity, Thermodynamics and Cosmology. By RICHARD TOLMAN, Oxford at the Clarendon Press. 497 pp. 1934.

TOLMAN'S Buch ist eine zuverlässige, ausführliche und klare Darstellung des gesamten Inhaltes der speziellen und der allgemeinen Relativitätstheorie. Dabei hat sich der Verfasser mit scharfem, kritischen Sinn auf eine phänomenologische Darstellung beschränkt und die zahlreichen Versuche unberücksichtigt gelassen, den Zusammenhang zwischen Gravitation und elektromagnetischem Felde sowie die Struktur der Materie durch die Methoden der Relativitätstheorie aufzuhellen. Dies erscheint durchaus berechtigt, da keiner dieser voneinander grundsätzlich verschiedenen Versuche bisher zu irgendwie überzeugenden Ergebnissen geführt hat. Auch die Versuche einer relativistischen Behandlung der Quantentheorie, die bekanntlich bisher nur zu Teilerfolgen geführt haben, sind in dem Buche nicht berücksichtigt. So ist es dem Verfasser nach meiner Ansicht gelungen, eine systematische Behandlung derjenigen Methoden und Ergebnisse der Relativitätstheorie zu geben, die dazu berufen zu sein scheinen, in jede spätere, in den Mechanismus des Geschehens tiefer eindringende Theorie einzugehen.

Besonders eingehend sind diejenigen Gegenstände behandelt, an deren methodischem Ausbau der Verfasser selbst hervorragend beteiligt war: die relativistische Fassung der Thermodynamic und das sogenannte kosmologische Problem, d.h. das Studium der Struktur des Raum-Zeit-Kontinuums im Grossen, welches von der räumlichen Ungleichmässigkeit der (astronomischen) Materie-Verteilung im Kosmos abstrahiert. Bezüglich des kosmologischen Problems eine Bemerkung, die sich nicht nur auf dies Buch, sondern auf alle neueren Publikationen über diesen Gegenstand bezieht: Die Einführung der kosmologischen Konstante in die "Feld"-Gleichungen war zunächst eine scheinbare Notwendigkeit, solange man daran festhalten zu müssen glaubte, dass die mittlere Dichte der Materie bezw. Energie in der Welt von der Zeit unabhängig sei. Die Einführung einer solchen Konstante ist aber vom theoretisch-formalen Standpunkt eine reine Willkür. Seitdem empirisch die Expansions-Bewegung der Stern-Systeme bekannt geworden ist, besteht vorläufig für die Einführung jenes Gliedes weder ein logischer noch ein physikalischer Anlass. Es scheint deshalb natürlich, bei der Behandlung des kosmologischen Problems von der Einführung des Λ-Gliedes abzusehen, solange sich für dessen Einführung keine zwingenden Gründe in der Erfahrung gefunden haben.

Besonders verdienstlich finde ich an Tolman's Buch die erschöpfende Behandlung der für die Nebel nach der Theorie zu erwartenden Gesetzmässigkeiten; denn diese erscheinen in erster Linie dazu geeignet, unsere Kenntnisse über die Struktur des Raum-Zeit-Kontinuums zu vervollständigen.

ALBERT EINSTEIN