only the botanists had been mentioned. Later, he does give high praise to the chemists, but he makes no mention whatever of the foresters who shared the same drenching rains and muddy trails with the botanists on the field surveys.

Actually, the first survey party in Colombia whose work is discussed by Dr. Steere was supervised by a forester and included two other foresters in addition to the two botanists and one chemist. If credit were to be given or even implied local B.E.W. (F.E.A.) officials as well as many individuals of the countries surveyed should be included also for their part in the work.

None would deny that Dr. Steere and the other botanists played an extremely important role in the cinchona surveys, and it is understood that any elimination was not done purposely, but rather, unintentionally in developing the interesting botanical notes. However, this supplementary mention of the part played by the forestry profession in the surveys seemed desirable, not to change the botanical discussions, but to clarify to any one not acquainted with the makeup of the missions the greater breadth of the crews who located and moved the cinchona barks.

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STARS IN AMERICAN MEN OF SCIENCE

I HAVE read with interest and some amusement the comments of S. S. Visher in the March 16, 1945, issue of SCIENCE on "Comparative University Strength in Scientists Starred in 'American Men of Science' V–VII."

It is my opinion that there is no true philosophical or scientific basis for the system of starring and, therefore, all investigations pyramided on the assumptions of starring are negative and, perhaps, even vicious. They have led, however, to many amusing conclusions, not the least of which is Visher's.

It might be more instructive to analyze the universities which Visher has selected, not only from the point of view of the relation of starred faculty members to the total faculty members, but what constitutes the universities under consideration and also their comparative endowments. For example, we see on Visher's list that Pennsylvania has fourteen starred members out of the teaching staff of 1,322, while Princeton has twenty-six starred members out of a teaching staff of 220 and Harvard has fifty starred members out of a total of 1,775.

Harvard and Pennsylvania have medical and dental schools, which Princeton has not. Harvard and Pennsylvania have law schools and certain other graduate bodies which, so far as I am aware, do not adorn old Nassau. Therefore, I think that Visher's inquiries should be confined to the fields in which men are starred. For according to Visher's analyses the Divinity School of Harvard is a liability rather than an asset when it comes to the proportion of men starred.

Princeton has a larger endowment than Pennsylvania, although apparently it has about one sixth of the faculty of Pennsylvania. Harvard has over four or five times the endowment of Pennsylvania and about 25 per cent. more faculty members. Harvard is usually considered the wealthiest university and yet, I believe, its annual income is no greater than certain state universities, whose appropriations by State Legislatures run into the millions. Neither Harvard nor Princeton receive money, as far as I am aware, from their respective states, and although Pennsylvania is not a state university, it does receive some state aid.

I recommend, therefore, that the next analysis of starred men takes into consideration the comparative wealth of the institution, not only from the point of view of endowment but also from the point of view of annual income from state, students and endowment.

A comparative salary study of professorships and other ranks in relation to starring should afford interesting instruction. I should like to mention that there are certain personality traits in institutions which should be likewise considered. Institutions, like persons, belong to upper, middle and lower classes, and by this is meant psycho-biological classification, not a social one. It is made of such factors as age, wealth, tradition, attitudes, vitality, connections, graduates and the like which constantly change and thus change the classification. It is this psycho-biological classification to which we refer when we say that such and such a place is not what it used to be; we refer to it in such terms as "The Big Three"; fresh-water colleges; or diploma mills, etc. I should also like to observe that some universities like Johns Hopkins or the Massachusetts Institute of Technology are more "national" in personality in contrast to certain other universities which seem to be of a more "local" nature. Such personality traits work an influence in attracting men and minds, in forming opinions; and perhaps even on taxonomists of universities and their faculties.

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EMPLOYMENT AFTER THE WAR

IN Dr. Joseph Mayer's article published in SCIENCE for April 13, it seems to me that two important agencies have been overlooked: (1) An organization to study the needs in goods, qualitatively and quanti-

tatively, of the country and (with a view to exports) of the world. For example, what is needed to keep all the people as physically fit as their natures will permit? (2) A great development of adult education, fitting the people to do the needed work. The astonishing success of the war workers shows how adaptable people are, if really interested and efficiently taught.

T. D. A. COCKERELL

SPECIAL ARTICLES

PRODUCTION OF IMMUNITY TO DENGUE WITH VIRUS MODIFIED BY PROPAGATION IN MICE[1]

THE purpose of this preliminary communication is to report, (a) the successful propagation of dengue virus in mice, and, (b) that beginning with the 7th passage in mice the virus had undergone such extensive modification in its pathogenic properties for human beings that consideration of its use as a vaccine seemed justifiable.

The work to be reported here is part of a systematic investigation of the virus of dengue with special emphasis on those of its properties which might lend themselves to the development of a vaccine. The work was carried on with five strains of dengue virus isolated by one of us (A.B.S.) from outbreaks of the disease in Hawaii and New Guinea.[2] The identity of the virus was established (a) by its capacity to produce in human volunteers a disease characterized by a fever of 4 to 7 days' duration, severe pain in various parts of the body, rash, lymphadenopathy and leukopenia with certain changes in the leukocytic formula, and (b) by its transmission after a suitable extrinsic incubation period by relatively small numbers of *Aëdes aegypti* mosquitoes.[3] Most of the studies were carried out with the Hawaiian strain of the virus for the following reasons: (a) it was the most virulent in the sense that it produced the most severe disease in human volunteers; (b) about 1,000,000 minimal human infective doses per cc were found in the serum of experimental cases during the first 24 hours of the disease,[4] and (c) having found that it had a particle size in the range of 20 mμ it was possible to obtain concentrates of the virus possessing more than 10,000,000 minimal human infective doses per cc by centrifugation at 24,000 r.p.m. for 90 minutes in an 8-inch rotor.[4,5] With these concentrated preparations of virus an exhaustive effort was made to obtain growth in cultures containing mouse embryo tissues and in embryonated chicken eggs of various ages, inoculated by various routes and incubated for varying periods at different temperatures, but with negative results. After 2 or more passages, the cultures produced neither disease nor immunity upon inoculation in human beings.

Dinger and Snijders[6] in 1931 attempted to propagate dengue virus from the Dutch East Indies by intracerebral inoculation of mice, but without success. Our own initial attempts to infect young mice in this manner with human serum of proved infectivity were also regarded as negative, but it must be stated that the mice were observed only for gross signs of involvement of the nervous system for the usual period of 2 to 3 weeks. In the first two attempts with concentrated, ultracentrifuged Hawaii virus, there was an occasional mouse that died or exhibited signs of nervous system involvement, but after one or two further passages negative results were obtained. On the third attempt with intracerebral inoculation of concentrated, ultracentrifuged Hawaii virus in 10 to 12-day old Swiss albino mice, it proved possible to transmit in series an agent which produced vaguely discernible to severe signs of nervous system involvement in a varying, and initially very small, proportion of the inoculated mice. However, 16 serial passages have now been completed and the tests with mouse-passaged material in human volunteers have established that the virus propagated in mice is dengue. Only 10 to 20 per cent. of the inoculated mice at first exhibited clinical signs of the infection (sometimes limited to slight weakness of the extremities demonstrable only by special tests), and the incubation period was frequently 3 to 4 weeks. Beginning with the 6th passage the incubation period

[1] This investigation was sponsored by the Commission on Neurotropic Virus Diseases, Board for the Investigation and Control of Influenza and Other Epidemic Diseases in the Army, Preventive Medicine Service, Office of The Surgeon General, U. S. Army, Washington, D. C. The laboratory work was carried out at The Rockefeller Institute for Medical Research, Princeton, N. J., and we wish to express our indebtedness to Dr. H. S. Gasser and Dr. C. TenBroeck for the facilities which were provided us. The participation of the inmates of the New Jersey State Prison at Trenton, N. J., who volunteered, without any offer of reward, to serve as subjects in these experiments, and the cooperation of the late Commissioner William J. Ellis, of the Department of Institutions and Agencies of the State of New Jersey, in providing facilities for this work at the N. J. State Prison, are hereby gratefully acknowledged.

[2] The specimens from Hawaii were provided on March 6, 1944, by Lt. Col. Clarence S. Moran, M.C., commanding the Central Pacific Area Laboratory, and those from New Guinea by Lt. Col. Cornelius B. Philip, Sn.C., of the U.S.A. Typhus Commission.

[3] Our associate, Capt. Wm. G. Jahnes, Jr., Sn.C., raised and took care of the mosquitoes used in these investigations.

[4] A. B. Sabin. Unpublished observations on dengue.

[5] We are indebted to Dr. Wendell M. Stanley for his help in the ultracentrifugation work.

[6] J. E. Dinger and E. P. Snijders, *Arch. f. Schiffs u. Tropenhyg.*, 35: 498, 1931.