deficient, but this, it seems to me, gives no justification for the following statement, which I quote from their paper:

> An impartial statistical study of the data from the individual orange groves shows that approximately one half the mottling *can be accounted*[5] *for* by the low humus content of the soil.

3. That all or nearly all citrus soils in southern California are deficient in organic matter has long been known. But to state that half of the mottling "can be accounted for" by deficiencies of the soil in humus when the other half of the mottling is not at all accounted for seems to me to be an unusual procedure.

4. Moreover, the method employed by Briggs, Jensen and McLane for determining humus, upon which much of their discussion depends, has already been pointed out by Gortner[6] to be insecure if not entirely inaccurate. In the writer's laboratory it has also been found that intensity of color is no criterion of the amount of humus. Moreover, no one has yet proved, and there is no justification for believing that the humus portion of the soil organic matter, as determined by any of the arbitrary methods in vogue, is of any greater value to plants or to soils than the rest of the soil organic matter.

5. That as the paper under discussion points out the total nitrogen content of soils is not related to the amount of mottling should be no cause for surprise since it is the amount of "available" nitrogen as the writer has on many occasions pointed out rather than the amount of total nitrogen that should reasonably be assumed to affect plant growth. This is especially true under arid soil conditions, in which, moreover, the term "available" possesses more than the usual significance.

6. It seems to the writer that we need a theory or theories on some definite and specific cause of "mottle-leaf" in citrus trees and not a description of some general condition like a deficiency of organic matter which can affect soils in many different ways, not always in the same direction, and which besides is universally recognized to constitute the most undesirable feature of arid soils.

7. As Briggs, Jensen and McLane point out, however, something which affects chlorophyll formation in the leaves of the citrus tree is responsible for the trouble. That factor, in my opinion, is a lack of usable nitrogen, and in view of the peculiar mineral conditions of our soils, it may in many instances also be due to a lack of usable iron.

8. The writer does not wish to be understood as denying the effectiveness of a lack or of a sufficiency of organic matter in the production or eradication, respectively, of mottle-leaf in citrus trees. He does desire, however, to deny that there is anything specific about the organic matter factor, since it can affect plants in one of so many different ways; that the portion of the soil organic matter known as humus is any criterion as to the activity and value of the soil organic matter; that the "mottling of orange trees has been definitely correlated with the low humus content of the soil per se; and that soluble organic matter placed in the zone of the feeding roots promises any better for the eradication of "mottle-leaf" than the practise of green manuring which, to put it mildly, has thus far fallen far short of the expectations originally entertained for it.

9. As I have pointed out in the papers above cited, we shall probably be compelled not only to supply sufficient available nitrogen to eradicate the physiological troubles of our citrus and other crops, but we shall have to make it usable by some method of soil protection which will make it possible for roots of plants to make use of the surface soil. The most promising method of soil protection now seems to be complete straw mulching.

CHAS. B. LIPMAN
SOILS RESEARCH LABORATORY,
UNIVERSITY OF CALIFORNIA

[5] Italics mine.

[6] "Soil Science," Vol. 2, No. 5, p. 395, November, 1916.

LORD LISTER ON THE VALUE OF VIVISECTION

TO THE EDITOR OF SCIENCE: The enclosed rough draft of a letter to "Dr. Keen" (as the envelope was endorsed) was found among the late Lord Lister's papers by his nephew and

biographer, Sir Richman J. Godlee and is published by his consent.

W. W. Keen

My dear Sir: I am grieved to learn that there should be even a remote chance of the Legislature of any state in the Union passing a bill for regulating experiments upon animals.

It is only comparatively recently in the world's history that the gross darkness of empiricism has given place to more and more scientific practise, and this result has been mainly due to experiments upon living animals. It was to these that Harvey was in large measure indebted for the fundamental discovery of the circulation of the blood, and the great American triumph of General Anesthesia was greatly promoted by them. Advancing knowledge has shown more and more that the bodies of the lower animals are essentially similar to our own in their intimate structure and functions; so that lessons learnt from them may be applied to human pathology and treatment. If we neglect to avail ourselves of this means of acquiring increased acquaintance with the working of that marvelously complex machine, the animal body, we must either be content to remain at an absolute standstill or return to the fearful haphazard ways of testing new remedies upon human patients in the first instance which prevailed in the dark ages.

Never was there a time when the advantages that may accrue to man from investigations on the lower animals were more conspicuous than now. The enormous advances that have been made in our knowledge of the nature and treatment of disease of late years have been essentially due to work of this kind.

The importance of such investigations was fully recognized by the commissioners on whose report the act of Parliament regulating experiments on animals in this country was passed, their object in recommending legislation being only to prevent possible abuse.

In reality, as one of the commissioners, the late Mr. Erichsen, informed me, no single instance of such abuse having occurred in the British Islands had been brought before them at the time when I gave my evidence and that was toward the close of their sittings.

Yet in obedience to a popular outcry, the government of the day passed an act which went much further than the recommendation of the commissioners. They had advised that the operation of the law should be restricted to experiments upon warm-blooded animals; but when this bill was considered in the House of Commons, a member who was greatly respected as a politician, but entirely ignorant of the subject matter, suggested that "Vertebrate" should be substituted for "warm blooded" and this amendment was accepted by a majority as ignorant as himself.

The result is that, incredible as it may seem, any one would now be liable to criminal prosecution in this country who should observe the circulation of the blood in a frog's foot under the microscope without having obtained a license for the experiment and unless he performed it in a specially licensed place.

It can readily be understood that such restrictions must seriously interfere with legitimate researches.

Indeed for the private practitioner they are almost prohibitive; and no one can tell how much valuable work is thus prevented.

My own first investigations of any importance were a study of the process of inflammation in the transparent web of the frog's foot. The experiments were very numerous, and were performed at all hours of the day at my own house. I was then a young unknown practitioner; and if the present law had been in existence it might have been difficult for me to obtain the requisite licenses; even if I had got them it would have been impossible for me to have gone to a public laboratory to work. Yet without these early researches which the existing law would have prevented I could not have found my way among the perplexing difficulties which beset me in developing the antiseptic system of treatment in surgery.

In the course of my antiseptic work, at a later period, I frequently had recourse to experiments on animals. One of these occurs to me which yielded particularly valuable results, but which I certainly should not have done if the present law had been in force. It had reference to the behavior of a thread composed of animal tissue applied antiseptically for tying an arterial trunk. I had prepared a ligature of such material at a house where I was spending a few days at a distance from home, and it occurred to me to test it upon the carotid artery of a calf. Acting on the spur of the moment, I procured the needful animal at a neighboring market; a lay friend gave chloroform, and another assisted at the operation. Four weeks later the calf was killed and its neck was sent to me. On my dissecting it, the beautiful truth was revealed that the dead material of the thread, instead of being thrown off by suppuration, had been replaced under the new aseptic conditions by a firm

ring of living fibrous tissue, the old dangers of such an operation being completely obviated.

I have referred thus to my personal experience because asked to do so, and these examples are perhaps sufficient to illustrate the impediments which the existing law places in the way of research by medical men engaged in practise, whose ideas, if developed, would often be the most fruitful in beneficent results.

But even those who are specialists in physiology or pathology, and have already access to research work seriously hampered by the necessity of applying for licenses for all investigations, and the difficulty and delay often encountered in obtaining them.

Our law on this subject should never have been passed, and ought to be repealed. It serves no good purpose, and interferes seriously with inquiries which are of paramount importance to mankind. Believe me, sincerely yours. LISTER

QUOTATIONS

SCIENCE AND THE GERMAN CIVIL SERVICE[1]

THE committee of the Institution of German Engineers urges that steps should be taken by modification of the law in the Confederated States, and particularly in Prussia, by removing the obstructions of the law of 1906 concerning eligibility for the higher posts in the civil service so as to make it possible that not only lawyers, but also graduates of the technical high schools should be able to take up careers in the higher civil service.

Already before the war, after exhaustive discussions extending over many years, the demand had been expressed that candidates for the higher posts in the civil service should be given a scientific academic training, so as to enable them to have a full understanding of the conditions of public life upon which industrial questions and the requirements of trade and commerce exert a preponderating influence at the present day. The war has confronted the state with an unexpected number of new problems that have caused it to call into its service the intellect of the most diverse professions. This extension of admission to the higher careers in the civil service that has been introduced under the pressure of the circumstances of the time must be extended, the barriers that still exist in this respect must be removed, if it is to be possible to ensure the full development of the economic forces of the country after the war. It has now become an imperative necessity that the demand that has been expressed for many years by the Institution of German Engineers should be fulfilled, and that university graduates, particularly of the technical high schools, should be admitted to the higher grades of the civil service, so as to place the selection for this career on a broader basis.

Already ten years ago, on the occasion of the discussions in the Prussian Diet on the government proposals concerning the change of the course of study for law (1903), and later, after their rejection, in the discussions on the law concerning eligibility for careers in the higher civil service (1906), the government admitted readily that the training of the higher civil service officials did not correspond with the requirements of the day. The removal of this defect was unsuccessfully attempted at that time by a proposed reform of the academic curriculum, and is supposed now to have been achieved by means of the law of 1906 by measures that only take effect subsequent to the academic study. Later experience has shown that the method that has been adopted is hardly likely to be able to impart to the coming generation of state officials a special understanding of the economic processes that govern life in our days. The training of the majority of higher-grade officials in the civil service and communal bodies that has become customary and has been determined by the law consists in a secondary school education that has a particular bias towards the humanities, and a short university course which is almost exclusively composed of legal subjects.

The course of study laid down for the lawyers is at the same time, and without change, also the course of study for the officials of the civil service. This rigid connection of profes-

[1] Translation in the London *Times* Educational Supplement of a letter in favor of the opening of the German civil service to men of scientific training which has been addressed to Herr von Bethmann Hollweg by the Institution of German Engineers.