help for his deformed foot and Lang for his injured knee. Duchenne walks the streets of Boulogne, his Faradic battery under his arm, and declaims against his critics. Lucas-Championnière, the ankylophobe protests eloquently against splints. Sayre captures his little patient in the New York slums still incased in his plaster jacket and triumphantly carries him off to his lecture theater.

"To assist myself," said Watts, the painter, "I converse with the sitter, note his train of thought, his disposition, his character and so forth, and having made myself master of these details, I set myself to place them on the canvas, and so reproduce not only his face, but his character and nature." So in this volume the author has absorbed something of the spirit of each pioneer and interprets that.

The general plan of the book is not a simple one with successive chapters following in orderly sequence for, as in a play, characters come and go and, whereas some cross the stage but once, others return again and again.

For instance the first chapters are biographical studies of Hunter, Hilton and Thomas.

Then follows the history not of a man but of a movement—that movement which led surgeons to practise tenotomy. The natural sequence to this, namely, the consideration of tendon transplantation and kinoplastic surgery is postponed until the story of the nerves and the control of muscles has been unravelled by Marshall Hall and those who followed him. The reason for this postponement is not far to seek. Scientific discovery and the application of principles are in history a disconnected sequence. Tendon transplantation has to be postponed in the book because the book is the interpretation of history and not a mere recital of events.

Later in the book when movement as a method of treatment finds its champion in Lucas-Championnière it turns out that the first three studies which appeared biographical are really historical phases of the contrasting doctrine of rest. Thus, being led to look at the subject from different viewpoints, we find the book full of surprises which arouse and renew our interest.

Only toward the end when dealing with bone and cartilage do we find a certain order, prescribed indeed by history but none the less stimulating because unexpected.

Valuable also is the last chapter on the history of bone-setting with a well-judged warning against the type of practitioner who, unsound in his fundamental knowledge, plays into the hands of charlatans.

In the rush of modern scientific life we are apt to ignore those who laid the foundations of our knowledge and even a discovery is often, as history shows, a rediscovery. "Our opinions," said Montaigne, "are grafted one upon another. Whence it followeth that the highest mounted hath often more honor than merit. For he is got-up but one inch above the shoulders of the last save one."

No student, seeking to know the history of investigation in the structure and function of the locomotor and nervous systems can afford to neglect this book and the story of "the last save one."

T. Wingate Todd

Western Reserve Medical School,
Cleveland, Ohio

THE PROGRESS OF UNDERGRADUATE RESEARCH IN MEDICAL SCHOOLS

Modern medicine is a scientific subject, and, in order to understand it completely, students must understand the methods by which the facts and theories of medicine have been acquired. The best way to learn the scientific method is by undertaking some research problem and so learning it first-hand. This is required for the degree of Ph.D. in a scientific subject, but students of medicine in some schools find it difficult or impossible to obtain the opportunity to do any research at all.

The faculty of the University of Pennsylvania are almost without exception believers in the educational value of undergraduate research, but the question of how properly to combine the time required for research and the exactions of the regular course remains an open one. Therefore, during the past session (1918–19) the William Pepper Medical

Society, an undergraduate society at the University of Pennsylvania, conducted a canvass of representative medical schools of the United States on the subject of undergraduate research. The attempt was made to determine the condition of undergraduate research, how the time for it was obtained, and what means (if any) were taken to encourage students to do this type of work. A somewhat similar canvass, conducted by Dr. C. K. Drinker in 1912,[1] permitted a comparison of the opportunities for undergraduate research in 1912 and at present.

The following letter was therefore sent to twenty-five medical schools:

DEAN OF THE MEDICAL DEPARTMENT.

Dear Sir: The William Pepper Medical Society (undergraduate) of the University of Pennsylvania desires to investigate the conditions under which undergraduate research work is being carried on in the principal medical schools of America.

The society believes that a knowledge of the methods of scientific research is of great value, and that greater opportunity to acquire this knowledge should be afforded to students who are interested.

We would request the favor of a reply upon the following questions, and hope that you will add any suggestions or comments that you would care to make. The committee would thank you for your trouble in the matter.

Very truly yours,
(signed) JOSEPH STOKES, JR.,
LYLE B. WEST,
ISAAC STARR, JR.,
Chairman,
Committee on Undergraduate Research

1. Do you allow undergraduates to undertake research in conjunction with their regular work?

2. Are any means taken by your faculty to encourage undergraduate research? If so, what means?

3. Approximately how many (and what per cent.) of your graduating classes have undertaken some research problem, under instruction of the faculty, during their regular course of study?

4. Does your curriculum permit a student to substitute time spent on research, under direction of a member of the faculty, for hours in the regular course, required or elective?

5. Do you believe that undergraduate research is justified by its educational value to the student?

The following tabulations were compiled from the replies of the deans of the institutions quoted except in the case of Johns Hopkins. As the dean of Johns Hopkins failed to respond, the attitude of that institution was ascertained from the catalogue and from conversations with undergraduates and therefore can not be regarded as entirely an official statement of that school.

By the answers to the first question we find that an overwhelming proportion of medical schools permit undergraduates to undertake research in conjunction with their regular work. Twenty schools allow this, two are doubtful (one of which gives only the first two years of the course) and only two forbid it. In 1912 seventeen schools permitted this, while eight opposed it. The opposition has shrunk from 32 per cent. to 9 per cent. in the last seven years.

Those permitting undergraduate research: California, Cornell, Colorado, Harvard, Illinois, Johns Hopkins, Leland Stanford, McGill, Michigan, Minnesota, Mississippi, Oregon, Rush, Texas, Tulane, Virginia, Washington (St Louis), Western Reserve, Wisconsin, Yale. *Those opposed:* Maryland, Geo. Washington (D.C.). *Doubtful:* Physicians and Surgeons (Columbia), North Carolina.

The following comment on question No. 1 was received:

Harvard—"Research is especially urged in certain departments." But, "There is a certain amount of opposition since men doing research at times neglect their other studies." (Letter of Assistant Dean Hale.)

In our experience the men who are interested in research have always stood well in their class. That this is also the experience of many medical schools is evidenced by their regarding the researcher as a "marked man." Any tendency to neglect other subjects for research could be easily controlled by requiring the student to maintain a general average somewhat above the passing mark while undertaking his research problem.

[1] SCIENCE, N. S., Vol. XXXVI., No. 935, pp. 729–738, November 29, 1912.

Reasons for a doubtful or negative attitude are given as follows:

P. and S. (*Columbia*)—"We do not advise it. Only a few can find time to do so." (Letter of Dean Lambert.)

Maryland—"We feel that the course is too comprehensive to allow the average student to spend time at anything other than his regular work."

The cause of the objections is the lack of time in the course. But the subject of medicine is a life study and can not be covered in four years. The value of a medical course must be measured not alone by the number of facts that the student masters during his four years at the medical school, but by the extent of his knowledge at the prime of his intellectual life. Therefore it seems strange that any school should not give its students some time in which they could work on their own resources, and, by learning to acquire knowledge without instruction, could become life-long students of medicine.

A study of the answers to question no. 2 reveals several methods by which undergraduate research is encouraged by the faculty. Several schols employ more than one method, which makes it difficult to classify them. The schools have been placed under the method on which they lay the most stress. These methods are as follows:

1. By personal advice and interest of members of the faculty—California, Colorado, Illinois, Harvard, Michigan, Washington, Virginia.

2. By allowing undergraduates to assist members of the teaching staff—Texas, Michigan, Tulane.

3. By requiring a thesis for graduation—Leland Stanford, Wisconsin, Yale.

4. By giving credit towards their degree—Rush.

5. By offering elective courses in research—Minnesota, Johns Hopkins.

6. Miscellaneous—

Cornell—"We encourage them by placing at their disposal every available facility for the study of approved problems." (From a letter of Dr. J. S. Ferguson, secretary of the faculty.)

Oregon—"All members of the class are at times assigned subjects to look up in the literature, bibliographies are at times required and these always suggest problems." (Letter of Dr. H. B. Myers, assistant dean.)

California—"Next year we are permitting two undergraduates to substitute for work in medicine, work in research which will be financed by scholarships from the university." (Letter of Dean H. C. Moffit.)

Schools which do not encourage it—George Washington (Washington, D.C.), Maryland, McGill, Mississippi, Physicians and Surgeons (Columbia).

From the answers to question no. 3 we find:

Over 50 per cent. of the graduating class has undertaken some research problem at Cornell and Yale.

Between 25 per cent. and 50 per cent. at California, Colorado, Washington.

Between 10 per cent. and 25 per cent. at Harvard, Leland Stanford, Minnesota, Rush.

Between 5 per cent. and 10 per cent. at Illinois and Michigan.

"Some little" at Mississippi, Texas, Virginia and Western Reserve.

None at George Washington (D.C.), Maryland, Physicians and Surgeons (Columbia).

Tulane replies that none of the present class has done any research because of the war.

We have no exact figures from Johns Hopkins, but the proportion is known to be high.

The fourth question is the most important one of the series because it determines whether research is made possible for the undergraduate. In order to work the undergraduates must have available time, sufficient in duration to allow for the completion of experiments. This time is provided in two ways: (1) by permitting a student to substitute time spent in research for hours in the regular course, or (2) by reducing the hours of instruction to such a point that enough free time is available.

The schools allowing students to substitute time spent on research are—California, Cornell, Harvard, Johns Hopkins, Minnesota, Oregon, Rush, Tulane, Washington (St. Louis), Wisconsin.

In 1912 only one school, Tulane, allowed such substitution.

Schools which have enough free time available are—Leland Stanford, Yale.

Schools permitting research but giving no time are—Colorado, Illinois, Michigan, Mississippi, Physicians and Surgeons (Columbia), Texas, Virginia.

In considering question five we find that a large majority is of the opinion that undergraduate research is justified by its educational value. The following medical schools answer affirmatively—California, Colorado, Cornell, Harvard, Illinois, Johns Hopkins, Leland Stanford, McGill, Michigan, Minnesota, Oregon, Rush, Virginia, Washington (St. Louis), Western Reserve, Wisconsin, Yale.

The schools which do not believe that undergraduate research is justified by its educational value—George Washington (Washington, D.C.), Maryland, Physicians and Surgeons (Columbia). The cause of the objection is the lack of time.

Mississippi, which gives only two years, is doubtful.

Reasons for favoring the proposition are given as follows:

Illinois—"Anything which stimulates a student to do independent thinking is justified." (Letter of Dean A. C. Eycleshymer.)

Michigan—"I know that those who have done some research are better students than those who have not." (Letter of Dr. V. C. Vaughan.)

Rush—"Because it is by all odds the most efficient pedagogic method." (Letter of Dr. J. M. Dodson.)

Virginia—"Where a man has the investigator's mind and is a sufficiently apt student to acquire his knowledge of the required subjects readily, such a man should be encouraged to do all the research possible and nothing in my judgment could be of greater educational value to this man." (Letter of Dean Theodore Hough.)

Washington—"We believe emphatically that undergraduate research is justified by its educational value to the student. In fact it is our belief, held generally in this school, that a piece of research may be of great value to a man in preparing him for the future. It is our opinion that the essential and most important object in medical education is to turn out men who will be lifelong (N. B.) students of medicine, and there is nothing more valuable in cultivating this spirit than the pursuit of first-hand knowledge along some line of interest." (Letter of Dr. G. Canby Robinson, dean.)

In view of these facts we conclude:

1. The vast majority of Class A medical schools approves of undergraduate research in theory.

2. Many medical schools approve of it in practise by conceding hours from their regular course which may be devoted to research.

3. The opportunity for undergraduate research has increased greatly since 1912.

ISAAC STARR, JR.,
JOSEPH STOKES, JR.,
LYLE B. WEST
UNIVERSITY OF PENNSYLVANIA

SPECIAL ARTICLES

COMPLETE REVERSAL OF SEX IN HEMP

THE writer has been investigating the sexual condition of hemp (*Cannabis sativa* L.) for a number of years and has obtained results so remarkable that he thought it advisable to present this preliminary note on certain phases of the problem before the completion of all the experiments and observations now in progress.

Common hemp was planted in the winter, when light conditions were very low, on shallow greenhouse benches heated mainly from beneath. Aside from these three special conditions, the environment was practically normal. Under the stated conditions, the hemp matures very early, sometimes having not more than two pairs of leaves before the terminal flower cluster appears and never being more than a few inches high.

The plants are staminate and carpellate and are decidedly dimorphic. The main sexual differences are as follows: Carpellate plant —broad flat crown of leaves, vigorous appearance but not so tall as the staminate plant, large root system, large leaf blades, carpellate flowers with the perianth a closed sheath and with no vestigial stamens, and a long period of life and growth. Staminate plant—slender habit and taller than the carpellate plant, delicate appearance, small root system, small