

physical phase of the philosophy seems far more likely to be cultivated by the devotees of theosophy and esoteric studies.

In conclusion, a passage from Lord Bacon: "I was ever of opinion that the philosopher's stone and an holy war were but the rendezvous of cracked brains that wore their feather in their heads."

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#### SCIENCE IN EDUCATION.\*

DURING the year 1895-96 there were in attendance at the colleges and universities of the United States nearly fifty thousand students who were pursuing courses leading to the degree of Bachelor of Arts, and of whom nearly ten thousand received that degree. In the various technological and professional schools there were sixty-six thousand students and nearly or quite fifteen thousand graduates. That is, those students seeking the so-called liberal education were less than forty per cent. of all the candidates for college degrees.

In none of the professional schools, with but few exceptions, is the possession of a college or university degree necessary for admission. A single medical school at the present time requires its matriculates to possess the bachelor degree, and some others will in the near future. In the theological schools a preparatory college education is more usual, but the whole number of theological students in the United States is relatively small, and does not seem to be rapidly increasing.

Nearly one-half of the professional students are those studying medicine, and of these I do not think more than five per cent. are graduates of other courses. Less than that percentage will be found among the engineering students, for reasons that will appear later. The profession of law,

\* A presidential address before the thirtieth annual meeting of the Kansas Academy of Science.

which is yet far behind the other professions in its educational requirements, has less than ten thousand students in attendance upon college instruction in our country, not one-third of the number of the medical students, though the members of the two professions in practice are much more nearly equal in numbers. A much larger proportion of arts graduates turn to the legal profession than to any other, in part due to the fact that the educational requirements of the legal profession are, in general, on so low a plane that the earnest young man is not content to enter upon his life's work with so slight a college preparation as it demands; in part because the ordinary college course offers better preparatory training for the legal profession than it does for any other, save the theological or pedagogic.

I am not aware of any statistics of the number of arts graduates among the active members of the professions in America, as a whole, but the number is clearly very small, certainly not one in ten, and I believe that there can be no question but that the percentage is steadily becoming less from year to year.

Our first impressions are that this fact is to be deplored. I believe, however, that it is rather matter of congratulation, inasmuch as it certainly means in the end better preparation for the active duties of life by the great body of professional men.

In no branch of education has there been more active progress than in that of medical education in the United States during the past fifteen years, and in none has there been a larger proportional increase of students. Twenty years ago, with almost no educational requirements for matriculation, nearly every medical institution in this country would graduate the average student after two courses of lectures, the second a repetition of the first, and each of but four or five months' duration. I have known students of average ability to re-

ceive the diplomas of some of the most renowned medical colleges of the United States whose entire medical tutelage was comprised within a period of less than one year's extent.

At the present time many require four years of college work, or shortly will, and these college years are often eight or nine months in length and are never less than six. Furthermore, they are not mere repetitions, but are graded from entrance to graduation with constant laboratory practice and frequent examinations. When the course was of but two years' duration more students relatively sought preparation in a more liberal education in the college of arts, for the same reason that seems to actuate many law students. Many of the law schools now require but two years' attendance upon college work and practically only nominal preparation for admission, and the majority of the practicing lawyers of our country have had no college professional training at all. The better colleges are now extending their course to three years, and it is only a question of a short time when the period of college study necessary for the reception of the legal diploma will be equivalent to that of the medical profession.

The modern educational requirements of the medical profession have, I believe, raised it to a distinctly higher plane than that of the law. To use the words of Justice Brewer: "A growing multitude is crowding in who are not fit to be lawyers; who disgrace the profession after they are in it; who in the scramble after a livelihood are debasing the noblest of professions into the meanest of avocations; who, instead of being leaders and being looked up to for advice, are despised as the hangers-on of police courts and the nibblers after crumbs which a dog ought to be ashamed to touch."

But this condition will not last long.

The time will soon come when everyone who appears before the bar of justice as an advocate will be a thoroughly educated man or woman. And does this mean that he will be required to have a four years' education in the college of liberal arts? Most certainly not. A four years' course in the law school will be required, whose certificate will carry with it the educational right to admission to the bar, and little or no attention will be paid to the so-called branches of liberal culture.

Conditions have changed much. The greatly increased competition and the greater struggle for existence now render it imperative that the professional man should be better grounded in the principles of his profession than he once was. The great accumulation of scientific knowledge has left the teas, the simples and the boluses for the quack in medicine. The lawyer can not be a politician, a real estate or insurance agent, and, in the intervals of his avocations, do justice to his client. The professional man can not spend much time in purely cultural and æsthetic studies, while his competitors are spending theirs in acquiring a knowledge of how to treat their patients or how to execute a legal document.

The average course in the college of liberal arts does not prepare for the studies of the medical profession, and not many physicians now urge young men to pursue the course in arts as a preliminary to professional training. A part of that time certainly is better spent in the more thorough mastery of the professional education.

The average age of graduation from the college or university at the present time is nearly twenty-three. The ambitious graduate in medicine will desire to give at least one year to hospital practice, or to travel before beginning his more active duties. He is then twenty-eight years of age, and two or three years more will certainly be needed

before he becomes an independent member of society.

And this is not the worst of it. In the profession of medicine, as in all other professions, book-lore or professional lore is only a part of the foundation for successful practice. A knowledge of mankind, of men and women, is more essential than a finished knowledge of his profession. At twenty-seven or twenty-eight a man is too old to acquire this knowledge in the best way; the plasticity of youth is waning, and new habits are hard to form. He must remain more or less controlled by his student habits, out of intimate touch with the great mass of the people and their inner life. And this lack of knowledge of human nature must surely remain as an obstacle to the most useful and successful practice.

President Eliot has said: "The average age of admission to Harvard College at this moment is fully nineteen. The student who stays here four years is twenty-three years old when he graduates. He then goes to our medical school to stay four years; so he is twenty-seven years of age before he has his medical degree, and we all know that some years intervene between that achievement and the competency to support a family. Now, that highly educated young man ought to have married at twenty-five."

The same conditions will surely confront the lawyer before long, and not only the lawyer, but the dentist, the theologian and students of other learned professions.

An answer that is brought as a solution for this unsatisfactory state of affairs is that the fault is in the preparatory schools. That poor teachers and poor teaching make the work of preparation for the college longer than need be, is very true, but I do not think that any relief obtained here will influence students toward the college of liberal arts. As teaching in the secondary schools become better and more efficient,

other subjects will be crowded into the high school course, filling in all the time that is saved. This will be of added advantage to the professional student and will more and more tend to lead him away from the college of liberal arts. Furthermore, none of the colleges of the United States have shown much, if any, tendency to shorten the course leading to, or render less difficult the requirements for, the Bachelor of Arts degree.

The entrance requirements for the medical and law schools are at the present time very unsatisfactory. The medical schools have labored unceasingly to increase them for the medical degree, during the past ten years, so far as professional knowledge is concerned, but they have done very little towards increasing the requirements for admission to the schools. In very few schools are they at all equivalent to those for admission to the freshman class in the better colleges of liberal arts. A very little knowledge of some foreign language, usually Latin is required; a little mathematics and a little physics, and a passable knowledge of English; but the student needs very little of what the world calls liberal culture, and practically nothing whatever is demanded.

After considering these chaotic entrance conditions to the professional colleges of law and medicine, it is refreshing to turn to another, in which, with but little pretension, with modesty and deprecation, rather, a model has been set which all the other professions will, in the end, surely follow.

The engineering profession to-day is, upon the whole, the best educated in America. While there may be a smaller proportion of highly trained men, there is also a far smaller proportion of poorly trained ones than in either medicine or law. It may seem strange that that profession which comes less into immediate contact with the general public should be, upon the whole, more highly trained than

those which touch so closely the pecuniary and physical well-being of every one. But the reason is not hard to find. The engineer is judged more by his peers, while the lawyer's or physician's success is dependent very largely upon the public. The capacity of the engineer must invariably be made apparent to men of affairs and ability, while the lawyer or physician is judged, for the most part, by those who are incompetent to determine his real merits.

Undoubtedly, as the years go by, more rigorous requirements will be demanded from the engineer, as from the lawyer and physician, but I do not believe that they will ever be very great in extent, save as new methods of teaching are developed, and these will require ability and capacity rather than time. The engineer may enter upon active life at the age of twenty-four or -five at the outside, fully grounded in the principles of his profession. No gap is left in his education between the high school and his strictly professional course, but the one grades into the other in an harmonious way. Though he graduates with the commonplace degree of Bachelor of Science, it represents, on the average, more college work than does that of Doctor of Medicine.

If, then, the learned professions are drifting away more and more from the college of liberal arts, what is the object of a general college education? What does the average young man or young woman have in view when he enters upon a four years' course leading to the degree of Bachelor of Arts? Undoubtedly the larger number have nothing definite in view. They are actuated, for the most part, by the desire for a better education, without any clear idea of what they wish to accomplish in life. Had the student in the high school a definite conception of his future work in life he would be more apt to seek that special training which would most enhance his prospects

for success. Many of the universities and colleges have endeavored to attract those students who have determined upon their life work, and who would otherwise skip the general college course, by offering some choice of studies, or by permitting the last year in the course for the arts degree to be spent in the professional school. This system of optionals has, perhaps, reached its highest development at Harvard and Leland Stanford Universities, where not only great latitude is allowed in the entrance conditions, but the whole college course is made up more or less fully of optional studies. That this system has been popular is shown by the more rapid growth of these and similar institutions as compared with the more conservative institutions, where many of the older classical requirements are yet rigidly insisted upon.

But, the system of optionals has gone quite far enough in some directions, not far enough in others. The average student, who has not yet made up his mind what he will do with himself, is bewildered and confused by the multiplicity of studies opened up before him. He is not competent to judge what is best for himself, and he needs at this time, more than at any other in his life, the advice and assistance of those who have gone before him over those labyrinthine roads; and he rarely gets it. The study of Chinese jurisprudence seems to have as much importance in the college curriculum as do other subjects, and, if the teacher is popular or 'easy,' he selects it. If he is working for his degree, as unfortunately most undergraduate students in the college are, he picks out the 'soft snaps' in college parlance and tries to double up on his studies that he may get through the sooner. Throughout all his preliminary course in the high school, as well as in his freshman and sophomore years, the study of language and mathematics has been strongly emphasized and he has had hardly

a glimpse of any other branch of knowledge. In the name of common sense, then, how can he be expected to have acquired any taste whatever for unrelated and dissimilar studies, or to have any conception of their relative importance? His advisers have been chiefly linguists and mathematicians, whose ignorance of the natural sciences is often equalled only by their prejudice against them. It is a fact that the larger proportion of those who have become students of the natural sciences have had their inclination formed despite of rather than by means of the university. The university seldom intimates to them that science studies ought to form an important part of their general training.

The result of all this desultory or biased study is that the student usually graduates without any clear idea of what he will do in life. He rarely studies with any definite aim, save that of getting an education, of the value of which he has little conception. He has been taught to believe that the best possible preparation for success in any department of life is a liberal education, and he does not trouble himself much as what his future career may be, resting self-satisfied in the delusive assumption that he will be fitted to enter upon anything.

It is true that the most earnest students that we have are those of the professional schools. A distinguished teacher of engineering has said: "It is unquestionably a fact that the engineering students of our colleges do more and harder work for a degree of equal grade than do the students of other departments." As a teacher of medical science I know that the average medical student does fifty per cent. more work than those of like capacities in the undergraduate arts courses. There can be no denial of the fact that the most earnest students are those who seek knowledge as a direct means of success in life rather than for the mere pleasure of its possession.

I believe, therefore, that the principle, now so largely adopted, which permits the student to browse about at his own will with a nibble here and a bite there, is wrong. He should be permitted and required early in his life to gaze upon the broad field of knowledge and at least to taste some of its enjoyments, in order that he may find out what his best and easiest path will be towards success. Away with the mediæval idea that a course in arts fits a man for anything. It does not and never will, unless it changes very much from what it yet is. As we have seen, the degree of Bachelor of Science in engineering, to which we may also add that in pharmacy, represents a larger degree of training and a greater knowledge than that possessed by the Bachelor of Arts. Why, then, does the latter assume such transcendent importance in education? Solely upon the claim of culture. How many are the sins that are committed in thy name! The classical student who has devoted five or six of the best years of his life to the study of the ancient languages, with little or no attention given to the modern sciences, is dwarfed and narrowed in his conceptions of life, even as the scientific student would be with no knowledge of the languages. Horace Greeley meant just such students as these when he said: "Of all horned cattle, deliver me from the college graduate." I by no means wish to deprecate the study of language and of philology. They are among the noblest that the student may undertake and well worthy of the ardent pursuit of the specialist. So, too, are the professions of law and medicine, but no one will presume to say that everybody should be a lawyer or a physician in order to be cultured.

At Yale College not less than nine or ten years of foreign language study are required for graduation, and not one week of any natural science. In the University of

Kansas, which may be taken as an average type of the Western universities, five years' study of foreign language must be had, and nothing whatever of any biological science.

Is that department of human knowledge which, more than all others, has been the foundation of the civilization of the present century; which has done more to lengthen life, to ameliorate its burdens, to improve, purify and advance the world; which has furnished one of the great underlying principles of modern education, of which even the philologist boasts—laboratory methods; which has established the great underlying principle of all progress—evolution; is this department of knowledge, I say, of so little importance that it is practically ignored in the requirements of a modern liberal education? Twenty-five years ago the classical course was the almost invariable one in our colleges; but even in those times I was required to learn the rudiments at least of physics, chemistry, botany, zoology and geology. Now modern education has liberalized the course by making the larger part of the language studies compulsory, and all, or nearly all, the natural sciences optional!

But the writing on the walls is so legible that he who runs may read. Yale College, the great exponent of the classical course, has been almost the only prominent college in the United States that has not gained materially in attendance during the past two years. Harvard, more liberal, does not insist upon so extended a study of the ancient languages, and will permit a considerable amount of science to be offered in their stead. Columbia College, which, until recently, has had requirements almost like those of Yale, has so modified its course that Greek is no longer demanded. To quote from its recent catalogue: "No one can obtain the degree of Bachelor of Arts who does not know something of at least one ancient language, and who has not

therefore looked out through this window upon the world of antiquity. He must know also something of history, something of philosophy, something of political economy, a good deal of English, something of mathematics, and something of a least one natural science. He must also have a reading knowledge of French and German." It is refreshing to learn of one college that does require the student to leave that window of antiquity long enough to learn something of one natural science, of the laws that control the world and its inhabitants. We may be profoundly thankful that all the universities do not insist that we shall look out through two windows upon the high morality and civilization of the old Romans and Greeks.

In thus claiming some recognition for natural sciences in the course of liberal arts I shall doubtless be accused of narrowness. I trust, however, if I am, that it will not be imputed to ignorance of the classical course. I studied, when a youth, Latin and Greek for the prescribed time of six years each, and have since learned to speak or read three or four of the modern languages.

But I do more than claim recognition for the sciences. I claim broadly and emphatically that the natural sciences, any or all of them, are as valuable and as necessary as pure cultural studies as are the languages; that intelligent and successful study of them will do as much, if not more, in making the student a broad man, a successful man, as will the study of Latin or Greek. And they will do more in making him an honest man. Nowhere in all the broad field of knowledge will he learn better to think exactly than in the natural sciences. Nowhere will he be more impressed with the importance of truth for truth's sake.

Among the graduates of the University of Kansas, with whom I am best ac-

quainted, there are not more than one-half who have had any training whatever in the natural sciences, with the exception of about ten weeks in physics and as many in chemistry, and perhaps a smattering of physiology. The simplest facts in natural history are as utterly unknown to them as is the prosody of the Hebrew language. A little, a very little, of biological science has been absorbed in the reading of fiction, of history and the newspapers.

The simplest functions of their own bodies remain for the most part sealed mysteries, the commonest laws of nature inscrutable. In fact, the ignorance of nature as a whole among the majority of the graduates of the so-called liberal colleges is usually abysmal in its profundity, stygian in its opacity. In the rules of philosophy they may be able to 'distinguish and divide a hair betwixt south and southwest side,' but are unable to tell the difference between granite and limestone, a polywog and a porpoise. In the laws of political economy they may talk learnedly and dogmatically, but are unable to locate the liver in their own body or to tell its functions. I verily believe that a third of the graduates in arts of our universities and a fourth of their instructors could not tell whether the pancreas is located above or below the diaphragm, or whether or not they have either pancreas or diaphragm at all. Grant Allen, in the *Cosmopolitan*, says: "Quite well-informed people will speak of a porpoise or a lobster as a fish; such grotesque blunders ought to be made impossible; they ought to be considered far more damnatory evidence of ignorance and ill-breeding than 'you was' or 'me and him went there.'" With such a standard how many college graduates are there who are educated?

President Dwight, in the same periodical, says: "In any future development of the college system the chief purpose of general culture should not give way or be subordi-

nated to any purpose of special culture with a view of some special work in future years." It is this spirit of culture for culture's sake that has dominated Yale College so thoroughly in past years and which makes the institution to-day the best type of the non-utilitarian education in America. The same conservatism is evinced in Professor Peck's attitude toward education. The classical student with him is a 'gentleman and a scholar,' while the scientific student is a 'sublimated tinker.' No wonder that he urges the unwisdom of a higher education for the masses of the people.

There is much in favor of the primary importance of mind-building in education, and no education can be the best that makes it subordinate to the mere acquisition of knowledge. But the position is assumed, by those who favor the classical education, that utilitarian studies may not be at the same time cultural; that one may not get useful knowledge and mind-building at the same time.

To use President Andrews' words: "Our strictures upon classical studies in college would have less weight were it not that these subjects crowd from the curriculum numerous others which would at least be equally suitable for college drill and incomparably more valuable later. The common opinion seems to be that, to be useful in disciplining the mind, matter for study must be useless for the purposes of life. There could be no greater error. Studies like social, political, physical and biological science, and modern literature and history, all of which are vitally important for intelligent men and women who must live and act their part to-day, are precisely the ones best calculated to enlarge, cultivate and strengthen the intellect."

The mistake that President Dwight and those who think with him make is in assuming that all men are capable of the broadest and highest culture, or that a

liberal education should be limited to those only who have such capacities. We urge upon the future student of medicine that he should pursue a liberal classical course in preparation for his professional training. He replies that he has no aspirations and no ability to be a leader among men; he seeks only the best education he can get that will fit him for a more humble sphere. He skips the college course and devotes all his time to his professional studies. In fact, the strictly classical course, such as Yale best represents at the present day, is perfectly adapted for but one class of people, gentlemen of leisure, who are not dependent upon their daily toil for their bread. One would not ask the hod-carrier to pursue a course in the ancient languages before beginning his apprenticeship. Nor should one require the same of the ordinary professional student.

As an opposite extreme to the conservatism of Yale may be cited Leland Stanford University, in which knowledge of the ancient languages is not indispensable for graduation. In this institution twenty-two subjects may be offered for admission, only one of which (English) is required, the remainder to be chosen from the twenty-one other courses. This list includes algebra, geometry, trigonometry, physics, chemistry, physiology, botany, zoology, drawing, American, English and ancient history, Spanish, French, German, Latin and Greek. In the college course certain groups of studies must be selected under advice, but this is the only restriction upon free choice. The effect that this latitude has upon the choice of studies is interesting. Of those who last year took their major work in Latin and Greek there were 76; in history and economics, 219; in mathematics, 29; in the natural sciences, 223; in modern language, 80; in English, 140. In the ancient languages 151 students were enrolled the first semester of last year; in the modern lan-

guages, 686; in mathematics, 148; in the natural sciences, 926.

The friend of classical culture may justly say that the education that seems possible at Leland Stanford is a narrow and one-sided one. A student who knows nothing whatever of the foreign languages is as surely a dwarfed and one-sided man as is he who studies the languages only and none of the natural sciences. It is not to be supposed that the students of Leland Stanford are of a different class from the students of other universities. There their choice is almost wholly unrestricted and the natural inclination away from the ancient languages is conspicuously shown. The only bachelor degree given for work in any of the lines possible is that of Bachelor of Arts.

When the old classical idea was yet so firmly inwrought into higher education that all else was leather and prunella, degrees of all sorts sprung up as mushrooms—Bachelor of Science, of Philosophy, of Pedagogy, of Music, of Engineering, of Pharmacy, of Agriculture, of Mechanics, and of goodness knows what. They were frank statements that such degrees did not mean liberal culture and were given rather as placebos. These degrees have, fortunately, largely been abandoned, the older degree of Bachelor of Arts supplanting them; an acknowledgment that liberal culture may be obtained in other ways than the old classical one.

I am aware that many will lift up their hands in classical horror at the bare suggestion that such a thing is possible as a Bachelor of Arts course in science, thoroughly convinced that the wolf has at last stolen bodily the raiment of the sheep.

The effect of the present requirements for the admission to the colleges and university of Kansas has been in a high degree disastrous to science instruction in the secondary schools. Chemical laboratories



that once delighted and instructed the high school pupils, the microscope and its world of revelations, the herbarium, the museum and the dissecting knife, have been abandoned and in their place Latin, German and French have been substituted. Of all the subjects required for admission to the State University, students come best prepared in Latin, because the requirements in this subject have been made most severe and important. Instruction in the natural sciences in the secondary schools of our State is superficial and imperfect in the highest and most astounding degree. Of all those who are candidates for the State teacher's certificate to teach the sciences it is the exception that one has as much knowledge of any branch as might be acquired by the diligent student in ten weeks of work; rare that an examination paper is the equal of those offered by the second-rate students in our University.

Put, however, the same emphasis upon botany, zoology, chemistry and geology that is given to Latin and the preparation would very soon be fully as good, fully as thorough. Let the high school scholar learn that the study of the natural sciences is deemed as valuable in his preparatory training as is language or mathematics and there will be no lack of good teachers.

Were I, then, to say what the universities and colleges ought to do it would be this: Make all the ancient language requirements for admission optional, and demand as much preparation in the physical and biological sciences as in the foreign languages. The preparation in English should be made far more rigorous and thorough. In the college course, if anything besides English is required, and I think there should be, I would have the natural science as necessary a part of the education as language and mathematics. I would not have it possible for a student to graduate from the college without having studied,

and thoroughly studied, mathematics as far as trigonometry, at least one foreign language, and at least one physical and one biological science. And I do not mean a few weeks of study in any of these branches, but exhaustive, careful, critical study.

The methods of study in all these branches are diverse and are absolutely essential for symmetrical mind-building.

Furthermore, an indefinite, haphazard selection of studies in the college course should be impossible. The course should be, so far as possible, adapted to the capacities, tastes and abilities of the individual, and this does not mean an indiscriminate selection on the part of the student. A person with feebly developed chest muscles might naturally prefer those physical exercises in which such muscles would take little part, but he nevertheless needs such exercise most.

It is through the great universities, and especially the State universities, that the solution of the problems of professional education must come, and in fact has come for some of the professions. With such cultural training as is best adapted to the lawyers's needs, the college course should include all the strictly non-professional branches, leaving the student, after he has completed his course as Bachelor of Arts in law, to take up the work of the professional school and complete it in two years with the degree of Doctor of Laws. In the medical course there are even greater opportunities than in law. The medical colleges should resign to the undergraduate arts course all the non-professional branches. And the work rightfully belongs there. The best chemical laboratories in the United States are not in the medical colleges, but in the universities. Nowhere are physiology, histology and anatomy better taught than outside of medical colleges. As in engineering, there should be an harmonious course leading through the high school to

the Bachelor of Arts in medicine, preparatory to two years of strictly professional work with the degree of Doctor of Medicine.

When such training as this is demanded of all aspirants to professional practice we shall have uniformly well educated men in the professions, and not until then.

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#### CURRENT NOTES ON PHYSIOGRAPHY.

##### THE REGION ABOUT LAKES TANGANYIKA AND NYASSA.

THE origin by down-faulting of the linear depression holding Lake Tanganyika has been advocated by Suess in 'Das Antlitz der Erde,' and popularized by Gregory in his book on the 'Great Rift Valley.' An article by J. E. S. Moore on the Physiological Features of the Nyasa and Tanganyika Districts (London Geogr. Journ., X., 1897, 289-300) gives additional notes of value. The south end of Tanganyika is enclosed on the west by a 2,000-foot sandstone escarpment, whence the plateau country slopes gradually westward to the shallow basin of Lake Bangweolo, whose waters are only ten or twelve feet deep; the plateau being broken by mountains of granite and gneiss which rise like islands above a sea. East of southern Tanganyika the country rises gradually; hence this part of the lake basin seems to lie in the depression between two tilted fault blocks, rather than in a *graben*. Passing southeast, the north end of Nyasa is found to lie between sandstone escarpments on either side, the enclosing uplands consisting of an uneven crystalline foundation whose depressions are occupied by sandstones and conglomerates like those around Tanganyika; this part of Nyassa is, therefore, regarded as a down-faulted rift. But going on to the south end of the lake and to its extension in Lake Shirwa, Moore finds nothing suggestive of great faults or rift valleys. Lofty

granitic masses, with axes about north and south, enclose wide areas of waste slopes and alluvial flats, whose central depressions are occupied by malarial swamps and shallow lakes. The outflow by Shire river descends to lower plains through the Murchison cataracts.

It does not seem to be fully proved that the depressions between the granitic ranges were not produced by dislocations, although it is true that, in the absence of the heavy sandstones, faulting is not easily demonstrated. It may also be questioned whether the existence of the depressions 'now more or less completely filled up with decomposed granite and gneiss annually swept down into them from the hills by the prolonged tropical rain' prove that they 'have undoubtedly at one time been covered by water.' It may be added that the rains are not, properly speaking, 'tropical;' Dove having advisedly limited that term to the rains produced where the trade winds ascend mountainous slopes; the rains here are subequatorial, dependent not on the trade winds, but on the annual migration of the meteorological equator from the geographical equator.

##### BRÜCKNER'S ERDRINDE UND IHRE FORMEN.

THE fifth edition of the standard Allgemeine Erdkunde, originally by Hann, Hochstetter and Pokorny, has for its second part a volume of 368 large pages on 'Die feste Erdrinde und ihre Formen,' by Professor E. Brückner, of Berne. It is a thorough and comprehensive work, but in its inclusion of Geology it illustrates how far Erdkunde departs from its supposed English equivalent, Geography. A quarter of the book is given to geology, including petrography, structure and stratigraphy; half of the pages treat of the processes that determine surface form, and the remainder are devoted to the forms themselves. Internal processes produce volcanoes, earthquakes, shore changes and deformations.