new to Science from his own collections made in Colombia and in those made in Ecuador by Dr. J. N. Rose. These collections have yielded to Dr. B. L. Robinson, of the Gray Herbarium, expert in the genus *Eupatorium*, some 20 undescribed species, and to Dr. J. M. Greenman, of the Missouri Botanical Garden, expert in *Senecio*, about a dozen. Many grasses new to science were collected by Dr. A. S. Hitchcock, Agrostologist of the United States Department of Agriculture, in Venezuela, British Guiana, Trinidad and Tobago, and those obtained by other collectors have been classified by him. Much important information about the Cacti and some 10 new species were obtained by Dr. J. N. Rose, in Venezuela and in Ecuador. Dr. S. F. Blake, of the Bureau of Plant Industry, has done much work on the Carduaceæ.

Mr. W. R. Maxon, of the United States National Museum, is engaged in identifying the Ferns and Fern Allies, Mrs. Britton, at the New York Botanical Garden, is studying the Mosses, and Professor Alexander W. Evans, of Yale University, the Hepatics. Dr. W. A. Murrill and Dr. Fred. J. Seaver, of the New York Botanical Garden, and Dr. J. C. Arthur, at Purdue University, have partially identified the Fungi collected. Several other students are investigating smaller groups.

Much desultory work in identifying plants incidental in various families has been accomplished by Dr. J. N. Rose, by Dr. B. L. Robinson and by me. In order to make comparisons with types and authentically named specimens, I took this summer several hundred recently collected specimens of several families to the Royal Botanical Gardens at Kew, England, and compared them with the great collection preserved in the herbarium there; the wealth of undescribed species in the region under study is well illustrated by the fact that I was able to match only a small proportion of them.

In order to obtain a view of the vegetation and to increase the collections, I spent March and April in Trinidad, the part of the region perhaps the best known botanically, but even there I was able to add some fifty species to the known flora of that island, some of them new to science, through specimens collected by myself and members of my party and by studying the fine herbarium of the Botanical Garden at Port of Spain.

The field work has mostly to be done by collectors sent from the north, but we have highly valued cooperation from Mr. W. G. Freeman, Director of Agriculture of Trinidad and Tobago, and Mr. W. E. Broadway and others of his staff; Mr. Henri Pittier, Agricultural Expert of the Venezuelan government, is sending material from that republic; when Dr. Pennell was in Bogota, Colombia, he secured the cordial cooperation of the Christian brothers there, who are forming a Natural History Museum, and when Dr. Rose was in Ecuador he secured the interest of Mr. A. Pachano; we are also assured of cooperation through the governments of French Guiana, Dutch Guiana and British Guiana.

The investigation is also adding much to the knowledge of the natural geographic distribution of species, especially as regards those ranging into Panama and the West Indies.

It is becoming increasingly evident that we should obtain as much exact information as possible concerning the vegetation of tropical and subtropical America.

N. L. Britton

New York Botanical Garden

PRACTICAL PSYCHOLOGY[1]

It is not easy to find an adjective describing adequately the applied psychology of tomorrow. "Solvent psychology," even apart from the alliteration, makes a certain appeal, for it designates a science capable of meeting all obligations; but the word has implications of deductive solutions reminiscent of metaphysics, Christian Science, psychical research, psycho-analysis, and other mysteries. William James, our distinguished master, has given

[1] An address before the Section of Psychology at the Chicago meeting of the American Association for the Advancement of Science, December 29, 1920.

such currency to pragmatism in philosophy that the word might be carried over into psychology. The dictionary, however, defines "pragmatic" as "officious, occupied with trifles"; so perhaps the word should be reserved for philosophy. "Practical," of the same origin as pragmatic, also illustrates the tendency of the meanings of words to deteriorate that throws a curious light on human nature. For as those who can do things have come to be called cunning, crafty, scheming, artful and designing, so those who continue to do things are looked at somewhat askance; when a famous letter used the phrase "you and I are practical men," the reference was not understood to be to perseverance in good works. However, we must do the best we can with a language imposed upon us when we were helpless infants; in so far as practical psychology means psychology based on the facts of experience, applied to useful ends and earning the means for its support and advance, it defines the kind of psychology that I wish to advocate.

It is no longer necessary to argue that psychology is a science resting upon experiment and measurement, that it is primarily concerned with individual differences in behavior, that it can and should be applied to promote human welfare. Psychology is much more concerned with what people do than with what philosophers think they think. Yet I look back to a time when I was in a minority —almost a minority of one—in urging these things. We are perhaps now no less dogmatic than our former opponents; as they once told us that the things in which we were interested were not psychology, so we to-day are likely to excommunicate from our fellowship any who hold that psychology consists of introspections of philosophers that are universally true but have nothing more to do with conduct than theology has to do with the control of the Being whose attributes it describes.

But those of us who believe in applied psychology still have to face and solve the problem of applying psychology to secure the support and advancement of psychology, and this from the standpoint of practical psychology is equivalent to the support and advancement of psychologists; for we obviously are the *verœ causœ* of psychological research. Progress there certainly has been. We are no longer little sisters in the house of philosophy. We supply an eligible list for every vacant presidency of a university or endowed corporation. We are paid about the same salaries and have about as many students, summer courses, extension courses and correspondence courses as our colleagues. In innumerable faculty and committee meetings we share their polyphasia and their apraxia. We also are permitted to devote our leisure time to research.

Psychologists are in somewhat the same situation as students of other subjects; but there are several distinctions. Having recently arrived and belonging to the comparatively *nouveaux riches,* we are self-conscious beyond the average; and as we propose to concern ourselves with the control of conduct we can be professionally occupied with the conditions under which we work, while in this regard others are only amateurs. If we can select college freshmen and telephone girls, we should begin at home and be experts in selecting psychologists for the laboratory; if we can determine the conditions under which factory hands work to the best advantage, we should be able to learn how psychological research can be accomplished most effectively; if we can describe and direct the complicated behavior of infants and children, we should be able to understand and control the simpler and more naïve official reactions of university presidents and trustees.

It is further the case that professional psychologists are at the present time a group so small that they can cooperate in a way impossible for the hundred and fifty thousand physicians or engineers of the country. The members of the American Psychological Association number 393, and there are not so many competent American psychologists, for the association does not undertake to exercise a censorship over the standards of its members. All American psychologists can get together in a room and each can be personally ac-

quainted with all. There are probably as many psychologists in the United States as in the rest of the world. The responsibility of each of us is large.

Why should we not unite to take over the psychological work of the country and conduct it in the interest of psychology? The railway men and the coal miners propose to manage the railways and the mines; but these are difficult undertakings, owing to the vast number of men and the immense properties that are involved. At present corporations, trade unions and other associations of individuals and interests are more potent forces in the social order than congresses or legislatures. Being unfortunately interested in the cost of printing, I have some information on that subject. The working printers by efficiently organized unions have been able to increase their wages beyond those of professors. The employing printers have in turn organized a United Typothetæ do deal with the compositors and the pressmen and more especially with the publishers and the public, which latter they have done effectively by increasing costs more than 100 per cent. Now a publishers association has been organized and there is also a writers union. It is the poor ultimate consumers who must take what is handed to them, though they too are beginning to cooperate.

As teachers or salaried experts psychologists are employees, but very few scientific men are employed primarily to undertake research. There is no reason why college and university teachers should not unite, as public school teachers are now doing, to increase their salaries, to secure permanence of tenure or to improve the conditions under which they work. Perhaps the first step in this direction taken by a scientific society was a resolution proposed by me and passed at the meeting of the American Psychological Association in 1912 to the effect that it is inadvisable for members to give summer or extension courses at a lower rate than their regular salaries. The association has also joined with the American Philosophical Association in a protest against dismissing a member from a college on account of the doctrines that he taught, and just now it is defining the qualifications for psychological experts. The American Association of University Professors has been expressly organized to safeguard academic freedom and the rights of teachers in so far as that can be accomplished by committee reports.

But such halting steps carry us only a short way. In our psychological research work we are not as a rule employees, but capitalists to the extent of the ability that we have. It is almost the only capital that can be used in this way; its earnings represent an enormous usury that accrues not to the individual but to society. This should be its ultimate destination; but if the capital is not increased and used to the best advantage, then all suffer. Research in any science is worth manyfold its cost; if an organized democracy can learn this fact and act accordingly the problem is solved. In the meanwhile it is our business to see that we reserve for research part of what we earn and use it to increase our working capital, namely, the number of competent psychologists and their opportunities to advance psychology and to apply it in useful ways.

Research and practise in psychology are not essentially different from research and practise in other subjects, except in so far as the inventions of the psychologist are not protected by the patent office. Dr. F. G. Cottrell has devised an admirable benefaction—if benefactions are ever admirable—by presenting to a corporation valuable patents, the proceeds to be used for other researches. But in general men earn their livings by teaching or applying science and advance it only as a sport. An expert and popular surgeon can earn $50,000 a year by cutting out appendices, but if he should by prolonged research discover a cure for appendicitis, he would be paid only in the fiat currency of honorary degrees or the like and would lose his practise. A professor of psychology can with the utmost difficulty increase his salary by his published researches; he can do so readily by becoming one of the house carls of the president.

Apart from using research as a kind of lottery in which men may draw better uni-

versity positions and hold them without further effort, so long as they observe all the proprieties of their social caste, the rewards and opportunities for carrying on research as a profession are few. The government does something; but it has scarcely discovered psychology, and its methods seem devised for the suppression of originality. Several foundations, munificently endowed from the proceeds of monopoly and a protective tariff, are providing for excellent research work; we may hope that psychology will some day share the spoils in case they do not involve any explicit or implicit controls. The research laboratories of the industrial corporations are the most promising development of recent years. There are more of these than there are university laboratories of physics and chemistry, and they probably already surpass academic work in quantity and quality, not only in applied science, but also in science not obviously or immediately useful. In this direction the Scott Company has made a beginning auspicious for psychology.

But as a rule scientific men are employees with a tendency to belong to the class of domestic servants rather than to the artisans with well organized unions. For not only are our wages fixed by the favor of superior officials, but we are expected to exhibit the virtues of the domestic servant and to submit to similar regulations as to wash days, days off, liveries, sweethearts, respectful speech and the rest. This situation obtains wherever scientific men are employed—in the government service, in universities, in research foundations, in industrial laboratories—though these seem to represent a series of increasing salaries and decreasing restrictions.

It need not be considered here whether it is in the interest of science and of society for teachers or employed experts to form unions; but it may be remarked that a point in their favor is the fact that teachers are now being dismissed because they belong to them. My argument is that while as teachers, administrative officials and institutional experts we are employees, as psychologists we are capitalists to the extent of our ability, originality and energy. We should form associations to employ our brains in the most useful and profitable ways.

Lord Kelvin was a university professor, an electrical engineer and a mathematical physicist. As a teacher he received a modest salary, as an inventor and expert he made a large fortune, as a scientific man his reward was to be president of the Royal Society and to lose his good name as William Thomson. For the latter circumstance, however, his money and his lack of an heir were largely responsible; Faraday did not become even a Sir. Kelvin was paid inversely as the value of his diverse services; but he could be comfortable as a teacher and command time, assistance and equipment for research through the means that he earned as an engineer. It is also the case that, if his teaching had been confined to research students, the three lines of his work would have been reciprocally helpful.

None of us is a Kelvin, but collectively we do work more important in teaching, in the applications of science and in research. Many individuals try to do the three things, but we do not have either the genius or the opportunity that Kelvin had. Correspondence courses, elementary text-books, pot-boilers, even the administration of routine tests, are not conducive to research, and may result in a sweat-shop system by which regular salaries are reduced below the living wage. But it would be posible for us to unite to use our resources for the common benefit of society, of psychology and of ourselves. The wage fund for teachers and experts is not fixed by unrepealable economic laws, but could be doubled by proper efforts. If one tenth of the economic by-products of research could be reserved for the workers, and a second tenth for the support of further research, if one tenth of the economic value of the applications of psychology could be paid to the psychologist who does the work and a second tenth be devoted to new investigations, then psychological research would be supported to an extent hitherto undreamed of in the his-

tory of science, and still society would receive eight tenths of our services as a free gift.

The tests of individual differences devised by a few psychologists in the course of the past thirty years have been dramatically exploited by the tragedy of war. These measurements of general intelligence and special aptitudes are interwoven with the whole fabric of the mantle of science, but the direct work of consequence involved in their development was done by a score of us in the intervals between the hours of our employment. When a committee was formed to adjust these tests to the needs of the army not even our traveling expenses were paid. An officer high in the army has estimated at a billion dollars the value of the gift gladly made to the nation; it would indeed have been so much if the war had been long continued. At a cost of about fifty cents each, tests were made on nearly two million recruits, and the value of each for purposes of promotion, elimination and selection appears to have been somewhere between ten and one hundred dollars. The economic value of such tests for school systems, for the government service, for industries, in all cases where individuals are selected for work, for promotion or for special tasks, is equally great.

By psychological tests made in an hour and at a nominal cost, we may tell better to what classes children should be assigned in school than can the teachers who have taught them for months. We may tell better from such tests whether a boy is fit for college or for a scholarship there than from a mnemonic examination in preparation for which years of his life have in large part been misspent. We may select recruits for promotion or for special assignments in the army more accurately than can their superior officers. We may determine the fitness of clerks, telephone girls and many other groups better than can their employers. With increased knowledge such as can be gained from further research, we may be able to double the productivity of labor by selecting individuals for the work for which they are best fit, all the way from the moron to the president of the nation. That would mean an annual increase in wealth of seventy billion dollars a year for this country, of five times as much for the world.

The productivity of labor can probably again be doubled by such improvements in the environment as it is within our power to make. This is largely the province of the material sciences, but the reactions of the human machine are of immense importance. There are innumerable problems awaiting investigation and solution. Such are: the desirable hours of labor; the most efficient movements; interest, enthusiasm and imitation; all conditions favorable or unfavorable to work or other forms of activity, including ventilation, heating and lighting; food, alcohol, coffee and tobacco; rest, play and sleep; posture and strain in employments, conditions of fatigue and safety, wherever the central nervous system, the neuro-muscular mechanism and the senses are concerned.

I am less sanguine in regard to our power to alter the constitution of individuals, but we can at least safeguard psychology from false claims, and it may be that the child and even the adult may prove plastic under the right conditions. The savage could not imagine turning iron into steel, still less turning steel into a cantilever bridge. Schools, churches, the press, the family, customs, laws, governments, are indeed all means to control and direct behavior. Their success in altering individuals has been but modest, and it is by no means certain that psychology as a science can accomplish much more than the Book of Proverbs to improve the situation. Perhaps it can do something, especially in the way of the elimination of futile and harmful methods, and a generation of research by a thousand able men might contribute results of immense value, measured either economically or in terms of human welfare. At present, however, and perhaps always, we can do more to alter the environment and to place individuals in situations where their reactions are what we want than we can to alter individuals. Fortunately all men are not born equal; it is both undesirable and impossible to make them equal, or indeed to alter fundamentally the

constitution with which they are born. But we can give them equality of opportunity and more; for we can provide the best opportunity for each and improve the environment for all. Even though it may be difficult to alter people after they are born, it may ultimately be possible to select the kind of people that we want to be born.

"The harvest truly is plenteous, but the laborers are few." And this is in large measure because we limit ourselves to the solution of St. Matthew: "Pray ye therefore the Lord of the harvest, that he will send forth laborers into his harvest." We do not use tested business policies to organize our work, but wait for the lords of the harvest to find us and to care for us.

> The fault, dear Brutus, is not in our stars,
> But in ourselves, that we are underlings,

or, in modern terminology, it is not the situation, but our failure to apply scientific methods to our own work, that makes us a feeble group gathered in Chicago when we might be a dominant force throughout the world. We should be practical men and see to it that we have a practical psychology.

J. McKEEN CATTELL

JOHN NELSON STOCKWELL

JOHN NELSON STOCKWELL, mathematician and astronomer, was born in Northampton, Massachusetts, April 10, 1832. When he was a little more than a year old his parents moved to Ohio, and at eight years of age he went to live with an uncle and aunt on a farm in Brecksville, not far from Cleveland. In speaking of his early education, he says he took very little interest in his studies until just before the outbreak of the Mexican War, when he became interested in history and, at the same time, began to solve arithmetical problems published in a weekly Philadelphia paper which found its way to Brecksville. It soon appeared that he could solve these problems readily and for a number of years he sent the answers to the paper week after week; he also worked every arithmetical problem he could find in old arithmetics which came into his hands. Algebra was not studied in the country schools in those days, and it was not until 1849 that he was able to begin work on this subject. He could find no teacher, but the subject proved to be so easy that he did not need one.

A total eclipse of the moon which occurred in November, 1844, first called his attention to celestial phenomena. From that time he was an ardent student of old almanacs and any other works which he could acquire dealing with astronomical events. When he was seventeen years of age, he secured a text-book on practical geometry and a year later began the study of general geometry, again without a teacher. So absorbed was he in mathematics that he found the work on the farm irksome and arranged to give less time to that and more to his studies. Olmsted's "Astronomy" and Dr. Thomas Dick's works gave him much practical information, but failed to satisfy him because they did not give enough theoretical work nor did they contain the mathematics necessary to predict astronomical events. The books he read frequently spoke of "La Place" and the "Mécanique Celeste." Young Stockwell, being determined to own this work, ordered it of a bookseller in Cleveland and received it in 1852, when he was twenty years of age. He found then, to his great surprise, that it consisted of four large quarto volumes and the cost was far in excess of anything he had imagined. But his desire for the work was so great that he was perfectly willing to give a half summer's work to get the money to pay for it. Before this time he had become somewhat familiar with calculus and was, therefore, able to understand much, if not all, of the content of these volumes.

From 1849 to 1851 he devoted all of his leisure to the study of geometry, trigonometry and higher mathematics, and in 1852 published a "Western Reserve Almanac of the Year of our Lord, 1853." By a mistake of the publishers his name was omitted from the title page and few, if any, knew the author. Soon after this he became acquainted with