PIONEERING IN PSYCHOLOGY

CARL E. SEASHORE

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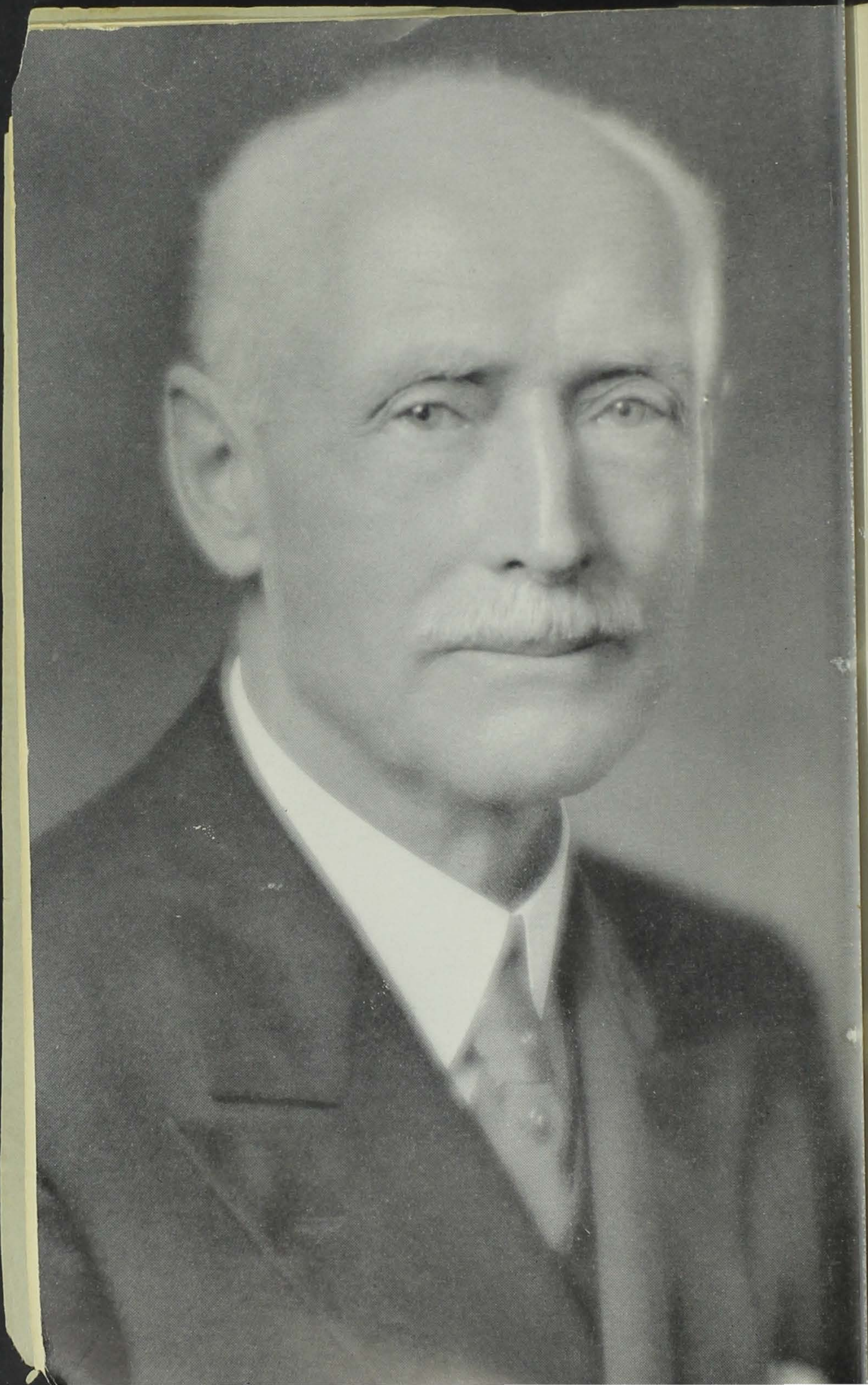
By

Carl E. Seashore



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By

Carl E. Seashore

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TABLE OF CONTENTS

CHAPTER		PAGE
I.	INTRODUCTION	1
	Scope, Origins, Analogy to Pioneering in Iowa at a Physical Frontier	
II.	THE PSYCHOLOGICAL LABORATORY	6
	The Founding of the Laboratory, Philosophy and Psychology, Psychology and Science, Psychology Pure and Applied, Interdepartmental Integration, Equipment, Buildings, Publications, The Staff, Graduate Degrees Granted, Dedication of the Laboratory	
III.	THE BUILDING OF INSTRUMENTS	38
	Audiometers, Tonoscopes, Tone Generators, Phonophotographic Cameras, The Piano Camera	
IV.	A VISIT TO THE ACOUSTICAL LABORATORY . .	51
	Phonophotography, A Performance Score, Harmonic Analysis, Synthetic Tones, The Piano Performance Score, Musical Robots, Measurement of the Expression of Emotion in Music, The Vocal Cords, Eye-Movements in the Reading of a Musical Score, Brain Waves	
V.	PSYCHOLOGY IN MUSIC	69
	The Growth of an Idea, Measures of Musical Talents, The Eastman Experiment, The Acquisition of Musical Skills, Critical Training vs. Artistic Performance, Science in Music	
VI.	PSYCHOLOGY IN SPEECH	110
	Origins, The Doctorate in Speech, The Theater, Phonetics, Acoustics, Linguistics, The Training of Teachers of Speech, The Preschool, Radio, The Line of Progress	

CHAPTER PAGE

VII. Clinical Psychology and Psychiatry . . 123

Before the Psychopathic Hospital, Conference on the Relations of Psychology to Psychiatry, Speech Pathology, Psychopathic Hospital, The Psychological Clinic, Psychometrics, The Reading Clinic, The Iowa Institute of Mental Hygiene, The Travel Clinic, Electrophysiology, The Position of Psychologists in State Institutions, A State Institution for Self-Supporting Morons, A Children's Mental Hospital

VIII. Differential Psychology 160

Intelligence Tests, Objective Achievement Tests, The Iowa College Qualifying Examinations, Orientation Techniques, Pre-Course Examinations, Sectioning on the Basis of Ability, Vocabulary Tests, Special Disabilities, Other Personnel Services

IX. Genetic Psychology: The Iowa Child Welfare Research Station 179

Child Development, Aspects of Genetic Psychology

X. Psychology in Education 190

"Brass Instruments" in Educational Psychology, Psychological Theory of Education, The Gifted Student Project, An Academic "Brain Derby," The Teaching of Religion in a State University, Physical Education, The Teaching of Psychology

XI. Psychology in the Fine Arts 212

The Graphic and Plastic Arts, Poetry, Recognition of Creative Work for the Doctoral Dissertation

XII. Retrospect 219

Bibliography 225

PREFACE

Pioneering in Psychology designates precisely the content and the flavor of this unique book. The winning of the American west coincided with the upsurge in scientific psychology; in Dean Seashore we have the only living representative of this great confluence of social and intellectual forces.

As a child, Carl Seashore was at home in the new world. He and his generation represented the pride and the hope of the rich new country that was opening up. What he learned in the intimate circle of farm-home, school and church, he carried with him as an inexhaustible source of strength and joy. Thereafter no complexities in scientific procedure or human frailty could long baffle him, or hold back his work.

This volume is at once a personal history and the biography of a large sector of a modern university in the making. In his dual capacity as head of psychology and dean of the graduate college over a span of three decades, the author, on many crucial occasions, came forward with a plan and a purpose. He combined direct action with an extraordinary power to envisage the shape of things to come.

What Dean Seashore has meant to psychology, psychology has meant to the University as a whole: the originator, the sponsor, the worker, the freedom-giving heart of pioneering adventures in science, art and education.

Among all of the University of Iowa's "lengthened shadows," Seashore's is the longest and the most enduring.

GEORGE D. STODDARD

Chapter I

INTRODUCTION

SCOPE

Having lived throughout the period of the development of psychological laboratories, I have for sometime thought of writing their history. Such a work is needed; but, to be of permanent value, it should be substantial and based upon extensive scholarly investigation. The task therefore seemed too large for a man who has to budget his years. I then thought of limiting it to American laboratories, but even that would be a large undertaking.

In going over the material in hand in regard to laboratories, I was impressed with the truth of Emerson's dictum that "an institution is the lengthened shadow of a man" and therefore considered the possibility of describing the men who had founded the laboratories and impressed their personal stamp upon them. That would be a suitable supplement to the autobiographies and historical sketches which have been published.

A history of this kind would, of necessity, deal more with men than with instruments and organizations. The two points of view, that of the founder and that of the laboratory, should really be combined, thus increasing the magnitude of the undertaking. Therefore I decided to take one step in the direction of the larger project by beginning with the Iowa laboratory where I have the facts in hand.

Since the scope of the undertaking had to be narrowed, I decided to limit myself to the portrayal of certain psychological *frontiers in which Iowa has pioneered under my personal leadership*. This limitation, however, leaves the account of the development of the department of psychology in Iowa but partially covered. Several of my colleagues in the laboratory should parallel this account with an account of their frontiers, which are numerous, but to which I can refer only incidentally.

Futhermore, it covers only the period of forty years, 1897-1937, in which I was virtually director of the laboratory and of which I can speak at first hand. The laboratory has made great progress in the

years after this period, but the events are too close at hand to be evaluated. New frontiers have been opened and my able successors will have the privilege of taking up the story where I have left off. After all, my theme is *personal pioneering in psychology*.[1]

Still other limitations are evident. The account is not documented; future historians can do that on materials available. Further, it is limited to my personal memories and biased point of view, with gaps due to lapses of memory. Many interpretations might be seen differently by others. Finally, I have taken license with historical technique in that the account is but a series of personal reminiscences. It is written in the spirit of a reminiscent pioneer.

ORIGINS

The title of the whole monograph might well have been *Origins*, since my object throughout is to indicate how significant movements in the field of psychology originated — how one new development sprang from another in the complicated links of the chain of progress. Thus, the second chapter aims to give an account of the leading factors that determined the character of the central laboratory and the department as a whole. Each of the following chapters is devoted to a description of origins of the respective fields in relation to taproots in the central laboratory. The chapters are limited to those factors which had a distinctive origin in the psychological laboratory of the University of Iowa under my personal initiative. This limitation, of course, leaves a full account of developments within each of these fields, both locally and nationally, quite untouched.

Psychology is still a frontier in science and the demand for pioneering in new vistas is ever increasing. The research atmosphere in this branch of knowledge scintillates increasingly with germinating ideas for new approaches to both theory and practice. Indeed pioneering enterprises in this area are just beginning.

ANALOGY TO PIONEERING IN IOWA AT A PHYSICAL FRONTIER *

My first real memory of the Iowa prairie is vivid and sweet. It is of the days in May, 1869, when the breaking-plow gang was at work to turn the virgin soil in preparation for cultivation. The plow

1 This volume is really an extension of a section by the same title in my autobiographical sketch: [In] *A History of Psychology in Autobiography*. Volume I. Worcester, Massachusetts: Clark University Press, 1930, 225-297. Edited by C. Murchison. There is, naturally, considerable overlapping; but on the whole, each supplements the other.

* The Palimpsest, 1941, 22, 178-183.

was drawn by three yoke of oxen driven by a man who walked to the side and forward, cracking a long whip and giving loud and continuous commands to the oxen. On the beam of the plow was a tool box, and the man who held the plow allowed me to sit on this box from morning till night. This was one of the greatest joy rides of my life.

To this day I can hear the ringing, crackling sound of the continuous cutting of tough roots; I can see the solid slice of soil about twenty inches wide roll over gracefully in a continuous fold; I can see and smell the May flora which covered that soil like a blanket in exquisite array of colors; I can re-experience the strain of the beasts against the plow and the plow against the resistant soil.

I felt myself in command of the prairie, the plow, the oxen, and the workmen. The memory of those days comes to me with a glow; it always comes to mind when I lecture on the richness, vividness, and persistence of mental imagery. Here, possibly for the first time, I was impressed with the grandeur in nature, the joy of conquering, the mastery of natural resources; here I felt awe bordering on the sublime. What jubilant days these were for the young boy — playing all day, associating with powerful men and animals, getting the thrill of satisfaction out of things done on a large scale. This was play at its best; this was the joy of conquest.

This pioneering experience of life on the challenging prairie was my first and unforgettable lesson in asking questions of nature by the progressive method in nature's kindergarten. It was the beginning of a life of exploration and investigation. I was then three years old.

My father, Carl Gustav Seashore (Seashore being a literal translation of the Swedish Sjöstrand) and my mother, Charlotta, bringing me and my one-year-old sister, Emma, had arrived from Sweden early that spring after a six-weeks' voyage across the ocean during which time my sister and I both had the measles. The last eighteen miles of our trip were made with an ox team, Tom and Jerry. Our destination was the future farm in Grant Township, Boone County, Iowa, the pioneer home-to-be. The eighty-acre farm had been judiciously selected by my uncle, Alfred Seashore, who had preceded us to the same locality. Here the pioneer life immediately began with plans for the cultivation of the soil and the building of a house. The original siding is still on the house which stands on the top of a hill overlooking an ideal plat of Iowa farm land.

The next fourteen years on the physical frontier in Iowa were

eventful in my education — full of opportunities, ventures, and thrills. I saw and had a hand in the turning of the wild prairie plot into a well-appointed homestead. It was a simple life, close to nature in all her wealth, hardships, and economies. In this frontier with but little capital to invest, we had to learn self-help and the art of making a self-supporting unit from resources at hand. As a boy, I had to learn to do everything that could and should be done in home-building — sowing and reaping, feeding and breeding, branding and butchering, breaking horses and opening markets, planting trees and grafting them, knitting and candle dipping, music and handicrafts in family, social, educational and religious life — all calling for initiative, forethought, ingenuity, and economy. A great school.

It was hard work. There was little or no machinery. I recall the primitive scythe, with its grain cradle. I started to plow when I had to reach up instead of down to grip the plow handle and could not lift the plow at the corners but had to train the horses to turn it correctly. To the barefoot boy, this soft smooth furrow stretching across the field was a magic carpet. Solitude in nature stimulated the flight of free imagination. Plowing did not interfere with thinking. I early set the pace for the hired man at work. Vacations were unheard of. There was no time or companion for the city kind of play. Everybody worked hard; early to bed and early to rise.

We had to fight grasshoppers with kerosene, we had to patrol the seeded ground against the clouds of game birds — ducks, geese, cranes, swans and prairie chickens. They were pests because they would pick up the sprouting wheat and corn. At times they darkened the sky like a cloud. Snowstorms were a serious menace on the treeless and wind-swept expanse. I rode horseback one whole night lost in a cold blizzard. At one time we had to dig a tunnel between the house and the cattle shed. Prairie fires were a dreadful threat. I have seen a cloud-like gigantic torch advancing at tornado speed toward our prairie grass surroundings. Clearings and backfire were our protection; yet at one time I saw the flames jump this and set fire to our woodpile. Snakes and other pests were rife, a menace to the barefoot boy who went around with a hoe trying to eradicate them.

There was at first no school, no church, no communal life; all had to be built up. But we were healthy, hardy and brave, and the mastery of each hardship had the promise of victory.

The rich black loam of Iowa responded and led to productive farming, and we were grateful to say that "it always rains in Iowa before

it is too late," and that "if it does not go very well, it will go very well anyhow."

The rich heritage that our family had carried from a eugenic stock in Sweden with health, morals, practical wisdom and religion was transplanted in a fast-growing community of immigrants from the same section in the mother country. Father stood out among them as a master builder and leader in all that was good. He built the schoolhouse with his own hands and became its first director. To facilitate acquisition of the English language in our family, we boarded the school teacher. Father built a church with his own hands and became its first preacher. He planted trees for a park as a center for community picnics. Burdens in the home therefore fell heavily on my beloved mother who, at every turn, breathed courage, practical wisdom and sympathetic leadership. In the meantime much responsibility was thrown upon their oldest son on the farm, in the home and in the affairs of the community.

> "In retrospect," as I have said in my autobiography,[2] "my boyhood education was of a primitive sort, meager in formal book learning, but rich and powerful in the challenge to cope with big situations. The freedom for vegetating in out-of-door responsible activities of rich and varied interests was a valuable substitute for pressure of brain work in a formal school training and confinement. Ours was a prolonged kindergarten set in reality with necessity as a teacher."

The physical frontiers have passed. It is now conventional to speak of other frontiers, many of which embody the same elements of pioneer life. My more than forty years in an active learned career in Iowa have been spent at a mental frontier, breaking ground for the new science of psychology. As an introduction to my account on the pioneering in psychology, I speak of these early experiences at the physical frontier. As I look back upon my life, there is a very close parallel between these experiences at the physical frontier and those at a virgin mental frontier. I trust that the analogy will vivify the psychological account.

2 *Ibid.*, p. 240.

Chapter II

THE PSYCHOLOGICAL LABORATORY

THE FOUNDING OF THE LABORATORY

The psychological laboratory of the University of Iowa was founded by George T. W. Patrick. In an article *The Founding of the Psychological Laboratory at the State University of Iowa*,[3] he gives an account of what we may call the first period, up to 1897. That article is written in his inimitably charming style, largely autobiographical and descriptive of the academic spirit and atmosphere of the time. In attempting a brief history of the development of the laboratory after 1897, I shall therefore begin my report where he left off and cover the forty-year period leading up to the time of my retirement from the directorship of the laboratory.

Historians will not be able to assign exact dates to the founding of American psychological laboratories, because they have all had a gradual inception. The Iowa laboratory, like the majority of the leading laboratories in America, made its substantial beginning in the 1890's as an outgrowth from earlier informal developments.

Patrick was a graduate of the University of Iowa. He pursued three years of study in the Yale Divinity School with electives in philosophy and was a student under G. Stanley Hall at Johns Hopkins, where he took his doctorate in philosophy. He made several visits to Europe, being especially interested in the work of the laboratories at Berlin and Leipzig. At this time there was a remarkable group of students at Hopkins, including Sanford, Burnham, Hyslop, Jastrow, Dewey, Donaldson, and Cattell, all of whom carried the new torch of learning into their respective fields with great distinction. "Some of this influence I brought with me to Iowa,"[4] writes Patrick with reference to his coming to Iowa as professor of "Mental and Moral Sciences and Didactics" in 1887.

In addition to his philosophy, he offered two courses in psychology the first year, one in empirical psychology and the other in experi-

3 Iowa Journal of History and Politics, Historical Society of Iowa. July, 1932.
4 *Ibid.*, p. 5.

mental psychology. These were followed without much change in the first eight years and drew heavily upon the large tomes of Wundt, Ladd, and James. He aimed from the beginning to illustrate with experiments wherever feasible. In 1892 he moved from the original class room in the Old Capitol to another building, Number 14 North Clinton Street, which provided ample lecture room, library and reading room, and three laboratory rooms. In the meantime he was collecting apparatus, mostly pieces which he had seen in use in Germany.

The first specific budget for the laboratory came in 1890 and an annual appropriation was continued thereafter. In the *University Catalogue* of 1890-1891 occurred the following announcement:

> The psychological laboratory is designed for the experimental study of psychology. Only a beginning has been made thus far, but at present apparatus is provided for testing the psycho-physic law, for the measurement of reaction times, for testing color-blindness, for mixing colors by rotating discs, and for exhibiting the structure of the brain and nervous system.[5]

The next year a list of the laboratory equipment was published in the catalogue.

"In 1895," he writes, "the department was enlarged by the coming of Dr. J. Allen Gilbert who had specialized at Yale, where he had taken his doctor's degree in experimental psychology. I had for several years been urging the appointment of a laboratory assistant fully acquainted with the technique of psychological apparatus and experimental methods. Dr. Gilbert proved fully equal to his task and contributed a great deal to the development of the psychological department." [6]

There is a unique significance to the term "assistant" in this quotation, reflecting the flavor of the spirit of the time throughout the country in the sponsoring of psychology. Gilbert and I had entered the psychological laboratory at Yale the day it was opened and received our doctorates there in 1895. I stayed on for two years' post-doctoral work in the laboratory and Gilbert came to Iowa. Gilbert was a brilliant and highly temperamental fellow, fully aware of his superior equipment as an experimental psychologist. He immediately began to chafe under the idea of being an assistant, regardless of his actual academic title. Two years later when I was called as his suc-

5 *Ibid.*, p. 12.
6 *Ibid.*, p. 10.

cessor, he wrote to me saying, "Seashore, you are going to hell." He himself abandoned psychology as a hopeless enterprise, proceeded to study medicine, and entered the medical profession in which he has made a fine record as a psychiatrist. His reaction was symptomatic of the underdog feeling of the sprouting psychologists under the powerful patronage of the philosopher-psychologist of the day. Naturally I was somewhat frightened by this.

However, I want to take this occasion to say most emphatically that in all my associations with Professor Patrick, I found him most delightfully congenial, generous, self-sacrificing, and helpful — in striking contrast to what my predecessor had pictured him. Patrick recognized my training and interests in psychology and made me feel that I was a psychologist and had a job in my own name from the beginning.

Both Patrick and Gilbert had engaged in significant research which resulted in the establishment of the *University of Iowa Studies in Psychology*, patterned after Leipzig and Yale. The first volume was published in 1897 with Patrick as editor.

The entire future of the department reflects the Patrick influence. The soundness of his plans, the wise and critical approaches to problems in the transition period, the sympathetic personal element injected into the laboratory associations, and his long presence on the campus with wise and sympathetic guidance may be seen throughout the developments of the later period. He is now professor-emeritus, living in Palo Alto, California, but his personality remains impressed upon the department. His former students and friends have expressed their appreciation of him as a teacher and friend by placing a bronze bust of him by Siems in the Iowa Memorial Union.

PHILOSOPHY AND PSYCHOLOGY

The Gilbert incident, which I have reported for its historical significance, was largely the case of a chip on a shoulder which took a tragic flip. In the background, psychology was pitted against philosophy although it took the form of a personal and localized clash. As that event was symptomatic of similar crises with shifting praise and blame in the leading American universities of the day; and, since it had a profound effect upon the development of laboratories in this country, I take the liberty of digressing briefly on the topic *Philosophy, the alma mater of psychology, and psychology, the rebellious offspring.*

In 1897 Patrick was listed as professor of philosophy and I as assistant professor of philosophy. In 1900 the name of the department was changed to the department of philosophy and psychology; Patrick was named head of the department, and my title was changed to assistant professor of psychology. I took no particular interest in this change as I was entirely satisfied with the old arrangement to which I was accustomed. However, the change is of historical importance, since it was the first formal recognition of psychology as something apart from philosophy and in parity with it in the division of labor in Iowa.

My office for the first four years was in the workshop. This was very appropriate as I was my own mechanician, secretary, textbook writer, instrument builder, and general flunky in charge of the rooms of the department, including the library. In this workshop I felt very much at home; indeed, my landlady boasted that I was the best roomer she had ever had, because I never came in at night until everybody else had retired and I went away in the morning before anyone else got up.

One day soon after my arrival, there walked into this sanctum a young woman with queenly bearing who came to see about registering in philosophy. She seemed to be struck with consternation as she blushingly viewed with surprise and disapproval myself, the littered workbench, and the mess of apparatus. She soon walked out. The next morning a friend of mine called and said that this young woman had confided to her that she had come to Iowa to study philosophy expecting to meet a dignified and philosophical-looking professor; and "here I found only a young man with an apron on in a messy workshop." Naturally she did not register, and I never heard of her afterward. Such was the first loss to philosophy in Iowa as a result of the "New Psychology."

The majority of the leading American laboratories came into fully recognized standing during the decade of 1890-1900. We may therefore look upon that decade as the beginning of an independent science of experimental psychology in America. The pioneers of that day were, in a sense, all starting from scratch. This seems strange in view of the fact that in the preceding decade we find the culmination of psychology in great textbooks, treatises, and monographs, some of which could well be kept up-to-date with but little revision. There were no significant little textbooks leveled at sophomores. The books were practically all in the form of from two to four large volumes.

In this country we had James' two large volumes, which will stand as an example of scientific literature with equal emphasis on "scientific" and "literature," brilliant, stimulating, generous, and critical. There were Ladd's four volumes, *Physiological Psychology*, and *Elements of Psychology*, and abridgments of each. Soon came Stanley Hall's two erudite and forward-looking volumes on the *Psychology of Adolescence*, and James Mark Baldwin's two volumes on *Genetic Psychology* and two volumes on *Genetic Logic*. These volumes together constituted a monumental collection of up-to-date information on psychology, more systematic, more dignified, and more literary than any of the current textbooks on the subject.

In Europe we had a parallel situation in Wundt's three-volume *Physiologische Psychologie* and his several volumes of *Philosophiche Studien*, Sully's two-volume *Psychology*, Stout's two-volume Psychology, the work of Bain, Ward's significant contribution in the *Encyclopedia Britannica*, the evolutionary approaches of Darwin, Spencer, Wallace and Huxley; and, in France, the clinical approaches of Ribot, Janet, Richet and others.

A shelf of the psychological textbooks available in the '90's would put to utter shame anything that could be assembled in this country or any other since that time, in the form of a comprehensive compendium, with one exception — that of Titchener's four-volume *Experimental Psychology* which soon followed. And yet the so-called founders of laboratories, as distinguished from their sponsors, in this country professed to start from scratch and in a way did so. That fact requires some interpretation.

Let me illustrate the contrast between the two with an experience I had at Yale. I went to Yale in 1892 to study philosophy and psychology under Ladd, who was then recognized as one of the most outstanding philosophers in this country. There were his four textbooks. There were his finished, really artistic, lectures to three hundred undergraduates in Osborne Hall. There were his pioneering seminars. Ladd, as a philosopher, had turned all his interests into psychology, and we felt immensely rich in coming into such a comprehensive and dignified approach to the subject of psychology. But Ladd, originally a preacher and author of several books on theology and philosophy proper, was giving us psychology at second-hand. He never performed more than one experiment; I performed that for him, and it was all wrong. He had amassed and interpreted relevant experimental material drawn from other sciences, notably physiology,

physics, mathematics, medicine, and biology. Practically none of the authors whom he quoted was known as a psychologist; and yet here was a very comprehensive and novel scientific presentation of facts about the human mind in true historical perspective.

In 1892, Ladd invited Scripture, who had come out of the psychological laboratory at Leipzig and had spent one year of research with Sanford at Clark University, to open a psychological laboratory as instructor in psychology. Naturally, I registered for this new course. It soon became apparent that he did not show what I thought was decent respect for the psychology of Ladd and his associates. Though thoroughly courteous, he took the position that psychology has to start from scratch. He conveyed the impression that the systematic statements in the learned books of the day might all be true, but they were nevertheless second-hand. This difference was very difficult for me to grasp, because I had the highest admiration for the wonderful acumen and power of exposition I was finding in Ladd and his associates; and our working busily with telegraph keys, chronoscopes, and smoked paper in the laboratory seemed utterly remote from interests in real information about the human mind. It seemed to me that Scripture had nothing to say or demonstrate that was in any respect comparable to Ladd's massive array of psychological facts.

The issue, however, came to a crisis in the selection of my topic for the doctoral dissertation. Going to Ladd, I said, "I would like to perform some experiments on the power of inhibition," a topic on which I then had only an inceptive but rather enticing notion. He said, "Yes, Mr. Seashore, that is a very interesting topic. You will find a fairly full account of it in my large volume, *Elements of Psychology*." I hadn't read that far in the book and therefore jumped at the opportunity to see if my problem was solved. I found the statement very lucid and comprehensive, and that put a damper on my enthusiasm for experimentation.

Not being entirely at ease, I went across Elm Street to Scripture and said, "I am very much interested in the subject of inhibition and would like to see if I can perform some experiments on that subject." Scripture, being an exceedingly formal and dignified person, for the first time eliminated the "Mr." and, slapping me on the shoulder, said, "Good, Seashore, try it." This had a magnetic effect; although then ignorant of what it implied, I date the birth of my scientific attitude from that moment. For the first time I sensed a feeling of companionship in a creative approach to psychology and felt that the laboratory

was going to give me satisfaction which could well compare with the deep satisfaction I had felt in the learned and all-comprehensive text-books. I cite this personal experience to give a concrete example of the chasm that was then forming between the "Old" psychology and the "New."

But, to come back to the sponsors of psychology, I want to pay my deepest respects to the authors of this period for their magnificent contributions through a scholarly résumé of the formative resources which at that time began to be recognized as psychological. The students of today would develop a proper sense of humility, historical perspective, and gratitude to our forbears if they were to begin their studies in psychology by reading a few of these two-volume textbooks before beginning their laboratory researches.

But what was wrong with them? What was it that led to rebellion? In the first place, most of the books were written by philosophers. These men were systematizers, thoroughly drilled in the arts of logic and scientific and philosophical criticism; but, with the exception of Wundt, they were not laboratory men. Their systematic psychology was relatively void of isms. Still the historian of today can go back to James' two volumes and find there a forecast, insight, and nucleus for practically every ism that has appeared in psychology in the last forty years. That was true in various degrees for the other men, but remained to be implemented by the laboratory invaders.

The incoming psychologist had a dominating goal — first-hand experiment; whereas, his sponsor, the philosophers, had an unparalleled art of logical insight and analysis in generalization. Without insisting upon such simplicity in the cleavage, we may say that this reflects the fundamental difference between the sponsors and the founders. It was the profound and irresistible devotion to the new idea of controlled, first-hand experimentation which rebelled against the systematic armchair organizer of experimental facts at second-hand.

The contest between the sponsor and the founder of the laboratory, which came to such tragic results by the demolishment of the Yale department at the end of this decade, was symptomatic of a crisis which affected the leading universities at that time, though with less serious results.

Here is a personal illustration of the sponsorship of philosophy. My researches for the doctorate had all been made under the direction of Scripture, who was treated as a technician, generously sponsored by the head of the department of philosophy. When in May, 1895, Ladd

asked me what I was going to do in the summer, I said I was going abroad as soon as I could qualify for the degree. He said in his magnanimous tone, "Don't let that bother you; go right away," so I sailed the following Saturday. He asked me to leave my thesis and all my laboratory records with him and wavied all formalities about examination and formal recommendations through committee, even the formal approval and acceptance of my thesis by Scripture. So I received my degree *in absentia* in a manner which leads me to apologize to the nearly one thousand candidates for whom I, as dean, have set up the final Ph.D. hurdles.

Experimental psychology has a long history but not under the title of psychology. It went through an epoch-making period in the last years of the century, through the systematic work of the philosophers. The philosophers of that day turned as a body to this new approach to their mental science. This represented a radical turning point in the interests and influences of philosophy. For the next twenty-five years in this country, which represent the rapidly formative period of the laboratories, the clash between the sponsors and the founders of psychology was greatly in evidence until the laboratories were gradually recognized as standing on their own.

The history of these clashes in America will constitute an interesting unit in the history of psychology. In many cases it was a contest between the old men and the young men; those in office and their employees. While philosophy granted the new approach, it can be said that on the whole it had a repressive and deterrent influence on the development of experimental psychology in a large number of the two-score or more laboratories which went through the formative period in the next two decades. The situation at Cornell University is perhaps the most extreme illustration showing radicalism on both sides.

I am glad to report that no such conflict arose for me in the University of Iowa. Patrick, especially through his contacts at Johns Hopkins, had become thoroughly imbued and acclimated to the experimental approach and stepped into the laboratory to do significant first-hand work himself, while I, as a newcomer, joined him with a philosophical background in training. Together we have enjoyed a life-long community of interests in philosophy and psychology.

Perhaps philosophy should have a word here, but the fact is that when Patrick, on account of frail health, withdrew from the headship of the department in 1905, I was made head of the department of

philosophy and psychology and remained so until 1927 when psychology and philosophy were made separate departments. Comments on that period of administration must, of course, come from the representatives of philosophy. The Iowa point of view has been that modern philosophy and psychology have much in common and can profit by intimate sympathetic associations.

PSYCHOLOGY AND SCIENCE

In the 1890's, the sciences justly looked with suspicion upon the claims set up by psychology for recognition. The philosophers cautioned wisely not to rush the claims, and the young men in charge of the laboratories were, as a rule, duly conscious of the limits of their offerings. Looking back now over a half-century period, one is impressed by the remarkable strides that have been taken in the rapid rise of psychology toward recognition. The inclusion of psychology with anthropology in the National Academy of Sciences and the National Research Council did much to establish the recognition of psychology in local institutions.*

For the first few years it was common to hear such questions as: Is there anything more in experimental psychology than the reaction-time experiments? Is a psychologist an anatomist, since his chief interest seems to be in dissection of the brain? Has philosophy become experimental? Can you measure any mental process? It was much later that psychology turned around and put up a claim for being a biological science. This claim came to a critical turn when the National Research Council was established. In that council, biology was classified under agriculture. At that time psychology had become clearly "biology conscious," but, given a choice of tying up with agriculture or anthropology, since it was necessary to double up, psychology logically enough chose anthropology; yet even so, joined more intimately in the division of labor within fields of biology.

The attitude of the Iowa laboratory as clearly crystallized under Patrick and Gilbert has been consistently a policy of concentrating research under laboratory conditions, patterned largely after physics

* As material evidence, I may mention that it was several years before I was admitted to the Iowa Academy of Science. My admission to Sigma Xi was opposed by the physical sciences for a few years. My son, a psychologist, was admitted to the scientific society of Gamma Alpha on the ground that he had a minor in geology; and this society was slowly recognizing psychology. Yet a psychologist had the honor of being the first scientist from Iowa to be admitted to the National Academy of Science. This gradual but rapid overcoming of opposition has been typical of most universities which built up psychological laboratories during that period.

and physiology. It is interesting to note that although for many years so intimately associated with philosophy, none of the extensive publications emanating from the laboratory has been of either a speculative philosophical type or of the prevalent type of uncontrolled observations. There has also been a persistent tendency to adhere to strictly psychological problems rather than to delve into problems of anatomy, physiology, or physics except in so far as that has been necessitated by the clearing of the psychological ground or the development of tools of investigation, such as physical measuring instruments. In this, I think the record of the Iowa laboratory is somewhat unique. In the growth of the university, psychology has kept well apace with the other sciences in research, in technical publications, and in the number of new scientific units which have come from it.

In the group system, the Iowa catalogue continues to classify psychology with the humanities. No one has thought it worth while to ask for its transfer to the biological group, although there has been a general trend in this direction throughout the country. Yet, for practical purposes, the subject has functioned with the greatest freedom for curricular purposes and for affiliation in research in both groups. If the issue were raised now, I would see no reason for wanting to transfer exclusively to the biological group. Fully accepting the current conception of psychology as a biological science, we must recognize that psychology is a mental science. Through its entrance upon problems — social, educational, economic and political — and through its approaches to the pure and applied arts, psychology more and more becomes associated with the humanities; or, it would be right to say, many of the disciplines of the humanities are affiliating with psychology, or even that biology is gaining new footholds in the humanities. Indeed it is the function of psychology as the basic mental science to develop and sponsor scientific techniques in all the mental sciences, both pure and normative. During the last fifty years the barriers between science and the humanities have broken down, and in this movement the staff of the Iowa laboratory has had a respectable share of leadership.

PSYCHOLOGY, PURE AND APPLIED

In order to establish their recognition among the sciences in this early period, the dominant attitude of the laboratory psychologists was that of displaying a halo of pure science unadulterated and uncontaminated by any interests of usefulness. In this, Iowa shared.

But the cries for help became loud and persistent at the door of psychology.

At that time there was no psychiatrist in Iowa or any training of physicians for mental treatment. Could psychology do something for the maladjusted child? And so we timidly set up a psychological clinic, so far as I know the second one by that name in this country, the University of Pennsylvania clinic being the first.

The new education was supposed to be based on psychology; and, since scientific psychology was to come out of the laboratory, cordial relations were established with the department of education. This early took the form of experiments on school children but was primarily of the brass instrument type as designated by James.

The laboratory measurements in hearing soon revealed the possibility of practical applications to music and so arose a division of the laboratory devoted to the interests of music; but always and only from the technical point of view of scientific measurements, the theory being that such work might well contribute to pure psychology and at the same time render a service.

From the approaches to music, the laboratory suddenly found itself in the heart of the psychology of speech, and out of that grew two basic approaches; namely, speech pathology and the scientific approach to the art of beautiful and effective speech.

Out of speech pathology came the establishment of the speech clinic. Similarly, a reading clinic was set up through a long series of experimental studies in which the entering students served as the clinical work material and in turn were served.

Then pressure came from the women's clubs of the state calling attention to the fact that science had accomplished wonders through research work at the state agricultural college in the improvement of the stock of animals and plant crops of many kinds. "Cannot psychology do something for the improvement of the Iowa child?" they asked and in answer the Iowa Child Welfare Research Station was established, becoming the parent institution of research units of that kind for the world.

Since audiometry had been developed through inventions in a long chain of experiments in the laboratory, the department of otology asked for help, which resulted in the training of a clinical psychologist for a full-time job in the measurement and analysis of hearing loss and the adaptation of hearing devices. This laboratory in the medical school was the first of its type on record.

The country gradually became conscious of the need of personnel psychology. Accordingly, leaders in the laboratory made some concessions to paper and pencil psychology by developing intelligence tests, qualifying examinations, and student personnel techniques, always with the intention of turning over the responsibility to a specifically organized unit as soon as possible.

The graphic and plastic arts, observing what significant contributions had been made in the scientific approach to music, invited co-operation; and through generous support of two foundations, the psychology of graphic and plastic arts stepped into leadership in the country.

With the establishment of the experimental theater and the demand for training of large numbers of students in the field of dramatic art, the practical science of artistic speech made marked headway both in drama and poetry. Closely allied with this is the marked development in the laboratory approach to the science of linguistics developed in co-operation with the department of German. Possibilities of new approaches to business and industry were seen. Thus, out of the psychology of advertising came the development of the now famous Gallup Poll; Gallup wrote his doctoral dissertation in that field, stimulating other researches in the same direction, and thereby doing a bit of pioneering which now holds the attention of the country.

One of the greatest satisfactions in this entire development is to see how one after the other of these units emerges with its own staff and assignments in the general University economy. The psychology of advertising, for example, was developed in psychology for a few years; but now all the practical aspects of that subject are taken over by commerce and journalism. One could go the rounds to demonstrate the operation of this principle. Indeed, in the rising scale of the University in the presence of new needs and facilities from year to year, the growth of a science is something like the growth of a family: father and mother start out alone, soon their children are persons in their own name, and their children — the grandchildren — carry their inheritance into new avenues of independent achievement.

The growth of applied psychology at the University of Iowa is strikingly unique: first, in the number of new approaches that have been made; second, in the insistence that all psychological contributions be made strictly in the spirit of the scientific laboratory; and third, in resisting attempts to replace the more practical or professional services.

While the aspects of applied psychology in our researches have naturally been the things that have been seen, felt, and spoken of, the original dedication of the laboratory to pure psychology has always been a dominant goal. Indeed, the applied goals have often been but means of vitalizing a theoretical issue. Witness the contributions in the psychology of music, speech, and child development which have been vitalized and validated against practical goals but have, as a rule, resulted in the deepening of our insight into the nature of normal mental operations. Our aim has been to catch the human mind in action. The fact that there has been a practical goal in sight has aided in the integration of the specific act with the total situation and in the fractionating of the approach to complex issues.

In general, psychology in Iowa has taken the middle-of-the-road attitude but with the greatest freedom for each investigator to develop or follow a new trend as much as he desires. There is no dominating school or polemic brand of psychology in Iowa. What is good in the isms will always be taken into account in experiment. But the processes in the psychological laboratory will, of necessity, be eclectic.*

For the first decade, our researches concentrated upon principles of normal illusions, containing beautiful illustrations of gestalt psychology. I prepared a manuscript for a book covering the field, but it was never published because I was unable to formulate a fundamental principle within the frame of which the mass of experimental data could be interpreted. I now agree with Koehler that this was gestalt, or configuration; the concrete facts were there. When the experimenter follows principles of rigid laboratory research, interest in the promotion of particular schools of thought falls into the background. The objective study of musical performance in the actual musical situation was behavioristic, although I have not always recognized the sweeping claims of the proponents of that theory.

INTERDEPARTMENTAL INTEGRATION

Perhaps the most significant policy of the Iowa laboratory has been the attitude of breaking down or ignoring departmental fences in the interest of give-and-take among departments. As we have seen, on this policy psychology has reached out into a dozen different depart-

* Personally, as director of research, I began in the atmosphere of the Wundtian psychology as did my American colleagues in the early formative period. I greatly admired the work of Titchener but soon realized the necessity of a radically functional point of view, such as came in under the influence of pragmatism and animal psychology.

ments, and in some cases into very close affiliations, but only by pursuing rigid psychological laboratory techniques. This policy of the department has met with extraordinary co-operation and reciprocity in other departments.

This principle is exemplified in education. Before I accepted the Iowa position, I had been appointed lecturer in education in Yale University. At that time I had read only three small books on education and had heard just one course of elementary lectures. But I was appointed presumably on the theory that a fairly well-trained psychologist should have something to say about the development of the human mind through instruction. The awareness of this anomalous situation has exercised a great influence on my personal attitude toward education at the University of Iowa and has given direction to the interdepartmental development.

Psychology in Iowa has always maintained a co-operative attitude toward education in the division of labor, without intruding upon the technical prerogatives of that field, and this attitude has been generously reciprocated. Education has required elementary psychology as a prerequisite to educational psychology, and it has been the policy for many years for a professor of educational psychology to hold a joint appointment in education and in psychology. Education has built up and maintained a strong unit in mental and educational tests and measurements. Psychology has supplemented this by technical contributions from the laboratory, involving the use of psychological instruments. In work toward advanced degrees in education, psychology has most frequently been taken as a minor; the two departments have had a joint library; the psychological laboratory has been available to students in education; and education in turn has reciprocated by building up a very well-equipped workshop for statistics. Education maintains a twelve-year model and experimental school with which the preschools of the Child Welfare Station dovetail. These schools are, of course, of inestimable value for genetic studies in psychology, especially in the field of learning. The clinical study and treatment of socially and educationally maladjusted children has been entrusted to the psychological clinic in psychology and psychiatry.

The college of education has maintained superior instruction in psychological statistics. The basic course of that subject has therefore been made a required subject in psychology. Instead of having either the psychologist or the educationist teach the more advanced mathe-

matics dealing with biometrics, that has been left to the department of mathematics, where a very good type of co-operation has been enjoyed, both for psychology and education. This has helped to place statistics on a sound mathematical basis for those advanced students who desire to specialize in that subject. This division of labor between elementary and applied statistics in education and advanced statistics in mathematics has been advantageous.

Physics is a good example of interdepartmental co-operation. The department of psychology was founded early; it had a mechanician before the department of physics did. When the new physics laboratory was built in 1911, an agreement was reached to the effect that physics and psychology should have one joint workshop located in the new building for physics, that it should be under the supervision of the department of physics but that psychology should be entitled to one-third of the time of the head mechanician, and should have free access to all the resources of the shop on the part of instructors, assistants and competent graduate students. As a result of this co-operation, a first-class workshop was equipped ready to serve two large departments. The question of equipment presents no difficulty, since the funds for the equipment of the laboratories all come from the same source in the University budget. This proved a very wise arrangement and has worked without friction, resulting in both economy and efficiency for the University.

When interests grew strong in the field of acoustics in the research work for music and speech, we were glad to discover that the head of the department of physics was doing research work in that field and was willing to offer a course in acoustics especially designed for students in music and speech. This course has been a prerequisite for much of the advanced work in these two subjects. Indeed, it proved so successful that the professor in charge prepared and published a textbook specifically from this point of view. It has been a very wholesome thing for students in psychophysics, psychology and speech to come in contact with a first-class authority in physics and enjoy the facilities of his equipment.

Instead of stressing courses in physiological psychology, co-operation has been maintained with the departments of zoology, physiology and anatomy. In anatomy, for example, our experience with physics has been duplicated by the head of the department of anatomy in the medical school who, realizing that we had a considerable body of students interested in the structure and function of the ear and the

vocal cords, volunteered to give a technical course on these organs in anatomy, with the facilities for dissection and technical instruction in that department. For more than twenty years that course has been given, nearly always by the head of the department, for one semester and a summer session each year.

Likewise, instead of teaching the conventional physiological psychology in the department of psychology, arrangements have been made for a choice of two advanced courses; one in the department of physiology in the medical school, and the other in the department of zoology. Another example of specializing in this field is the course in heredity, which is given by one professor to students in medicine, zoology, physiology, and psychology.

Co-operation with philosophy has, of course, always been close, and students in psychology have had the privilege of courses often designed specifically for them, such as the logic of science and various other courses having a bearing upon the philosophical background of psychology. It is notable that philosophers have tended to gravitate toward psychological interests in research.

One activity sponsored by philosophy but from the psychological point of view was a project in character education. For several years Professor Starbuck threw his best energies into this field of investigation and early gained national recognition by receiving a $10,000 prize for the best work done in that field. The project received substantial subsidies from foundations, drew large numbers of research students, and resulted in many publications. The methods of research, however, were frequently of a different order from those recognized in the psychological laboratory, and the result was that the project stood for many years as a thing in itself, apart from philosophy, psychology, and education and was regarded as an independent research institute. Through this channel the institute assembled a valuable collection of books having a bearing on character education for children; and a staff organized for this purpose classified and evaluated these and published guide books and later, source books for such readings.

One of the most valuable outposts for psychology has been the Psychopathic Hospital. This hospital is an experimental institution limited to sixty resident patients together with out-patient service. As soon as the hospital was established, the psychological clinic was located there. A professor of psychology was recognized as being in charge of this clinic in co-operation with and more or less under the

direction of the head of the hospital. Thus students of clinical psychology have had access to patients, have come into contact with the various resident psychiatrists, and have had the opportunity of doing research both on children and adult patients under the most favorable conditions. It is safe to say that both psychiatry and psychology have profited by the co-operation. In the pioneering era, this arrangement has done much to set the pace for such a type of fraternizing between psychology and psychiatry and for the wholesome development of their common interests.

It is perfectly evident that clinical psychology should be taught by a psychiatrist and that psychiatry that is to be useful for psychology must be oriented with the approaches from the psychological and educational points of view. The interests of education and research in child development have been integrated. A branch of the clinic has been maintained in the psychological laboratory which enables the University to take care of educational and adjustment problems of children outside the hospital.

Perhaps the greatest acquisition of help from outside has been the Iowa Child Welfare Research Station, which is primarily a psychological institution. Since this has been well financed through outside agencies in addition to state funds, for the last twenty years we have had a considerable staff of psychologists whose entire time has been devoted to genetic studies in child development and the training of students for leadership in research within this field. Students qualified in psychology have had the privilege of contact with these specialists in genetic psychology and have shared in the facilities of the preschool and the research laboratories in the field of child development.

The establishment of a chair in the psychology of otology in the medical school has been advantageous, especially for students interested in acoustics, in that the psychologist in otology has given a graduate course in acoustics and has encouraged research in related problems.

In recent years the co-operative arrangement with the department of speech has greatly enriched our offerings in various branches of acoustical psychology, and has led to branching and rebranching of research facilities. Thus, in addition to speech pathology, for which there is a considerable staff in the clinic, the science of speech is now distinctly on its own footing although it has one base in psychology and one in speech. There is a large body of students enjoying the facilities for dramatic and other artistic speech with the privilege of

taking the problems into the laboratory under psychological direction.

Parallel to this is the psychology of acoustics extended into linguistics by maintaining a branch of the laboratory in co-operation with the department of German and devoted entirely to acoustical approaches through research in linguistics.

The building up of substantial contributions to anthropology and biometrics through the co-operation of child welfare and physical education has been the principal factor in placing research in the field of physical education on an academic basis and has introduced students of physical education to psychological approaches to that subject.

It will be seen that this extraordinarily large offering for psychology from outside the walls of the department is not simply in the freedom of psychology students to go out and elect courses in other departments but in a very active co-operation of other departments in setting up facilities for courses and research especially adapted to the needs of psychology.

To repeat, the privilege of approaching physics under physicists, anatomy under anatomists, physiology under physiologists, mathematics under mathematicians, etc., cannot be overestimated, and the extent to which that privilege has been offered in Iowa is perhaps unparalleled. This arrangement has also facilitated the encouragement of membership of the staff of persons from radically different schools and with distinctly varied points of view.

In 1926, the department published a circular illustrating with a diagram our conception of the relation of psychology to other subjects on the campus at that time. The legend to the diagram may be of some historical interest. It ran as follows:

Philosophy: Problems in common, such as the philosophy of mind and psychology of logic, of ethics, of aesthetics, and of religion.

Religion: Pyschology in its various aspects as a foundation for religious theory and life, with special reference to religious education and character education.

Music: The psychology of music studio.

Art: Researches for the foundation of a psychology of art studio.

Speech: Psychology the main background for a scientific study of speech; co-operation in speech clinic; phonetics.

Sociology: Dovetailing of anthropology, social psychology, and other courses.

Physics: Shop in common; course in the physics of sound; co-operation in research.

Zoology: Physiology of the brain and sense organs taught as animal biology; "speculative zoology" as related to comparative psychology.

Otology: Psychologist in the psychophysics of hearing; co-operating in research and in speech clinic.

Commerce: Dovetailing of courses in the psychology of advertising and personnel with courses in labor and marketing.

Psychiatry: The psychological clinic; the psychiatric unit for field work; the animal laboratory; interchange of courses; psychologist in psychiatry.

Hospital: Medical service for a psychological clinic and speech clinic.

Public Health: Mental hygiene, in health and disease.

Public School: Psychiatric unit; mental surveys.

Child Welfare: Research and seminars in the psychology of the normal child; preschool laboratory; genetics, eugenics; mental and social surveys.

Education: Intimate and enriching co-operation in the common fields of psychology and education recognizing the value of a two-fold approach both in courses and in research.[7]

With this rather bold expansion into applied fields, we may rightly ask: What happened to pure psychology, as such? There are two approaches to applied psychology: one is the attempt on the part of the psychologist to go out and render a service with the material in hand; the other is to introduce some sound psychological technique for laying a corner stone to a possible structure in some field of applied psychology. The latter has always been our point of view. None of the fields into which we have entered has been approached by the way of lectures or other teaching devices. Our approach has always been through some experiment. In the course of development in the laboratory, we have found significance in a specific applied field, and our follow-up has always been experiment and more experiment in order to lay foundations for some phase of a practical discipline. Pure psychology has always been our central aim and interest; but in support of the attitude which is stated, we find that contributions to general psychological theory (in the way of accumulating facts bearing on pure psychology) can come just as profitably from an experiment in which an ultimate practical interest is foreseen, as in an experiment without any practical objective. Our work on illusions, for example, proceeded for many years without the slightest thought of application, and substantial contributions were made to the theory of perception through these experiments. Then out of a clear sky came the observation that everything that was known about an illusion in localizing sound by binaural waves was called for to provide a

7 Psychology and Service, Bulletin of the State University of Iowa, New Series No. 364, June 25, 1926.

system for locating submarines in the war. Up to that time we had studied it purely in the interest of beauty and of research on the laws of illusion. Likewise, when interest was awakened in speech pathology, the various approaches through electrophysiology and bilateral waves of the brain were basic approaches in physiological psychology.

EQUIPMENT

The Iowa laboratory was patterned after the Leipzig and the Yale laboratories. The deciding factor for the developing equipment from the beginning was concentration upon problems in which exact measurement of a psychophysical nature characteristically could be made and analyzed to give a qualitative insight into the structure of the mental processes involved. This called for the development of measuring instruments of precision and techniques for the control of the conditions of the measurement. This has in recent times been spoken of as "brass instrument psychology." That attitude was characteristic of all the laboratories in the '90's and a large part of the next decade or two.

The adoption of this principle has been adhered to with special emphasis upon the development of systematic psychology, but its greatest significance lies in the fact that it was carried over into the various forms of applied psychology which have been launched from the central laboratory. There have been two fundamental exceptions to this policy: first, in the recognition of the clinical method in which it could not be applied rigorously; and second, in the paper and pencil approaches to so-called testing programs which originated in the laboratory. But in both of these cases, the Iowa contributions have been characterized by the fact that the principles of scientific measurement prevailing in the laboratory have been adhered to so far as possible. This is illustrated in the development of personnel procedures, personnel measurements, and the psychology of art.

From the very earliest period, the psychological laboratories were confronted with the necessity of devising new measuring instruments and building them for their individual use. From the very beginning much more money has been spent in the Iowa laboratory for building new instruments of local and original design than for the purchase of standard instruments and equipment. For this reason the laboratory has centered around the shop. The type of instrumental design has changed radically from period to period in the development of new psychological approaches and interests. For example, we began in

Iowa by building audiometers, chronoscopes, graphic recording devices, and tonoscopes. As the center of interest early began to concentrate upon problems of hearing, the laboratory specialized more or less in acoustical equipment. When the laboratory reached out to the Psychopathic Hospital, the techniques of electrophysiology were becoming available, and the design of instruments turned heavily in that direction.

When the vacuum-tube technique became available in the field of acoustics, the equipment was radically revamped from the original mechanical instruments, such as tuning forks and devices for the measurement of frequency and intensity. We came in on the ground floor with progress made in the development of tone-production, measurement, transmission, and analysis which was built up during the last quarter of a century. This played right into the hands of electrophysiology in the development of action-current techniques and especially in the measurement of brain waves, but perhaps more than anything else in the development of psychophysical techniques in acoustical measurements underlying approaches to the psychology of music and speech. It is significant that in the speech clinic emphasis has continually been laid on technical measurement with laboratory instruments as opposed to mere clinical observation.

As such things go in universities, the Iowa laboratory has been treated fairly generously. We began with an annual appropriation of $500 for instruments. This increased gradually as the laboratory grew so that after forty years it amounts to about $2500 a year in the regular budget. The University has two sources of support for laboratory equipment: first, this general budget through the college of liberal arts; and second, the research budget through the graduate college. Through the latter budget the laboratory profited greatly by the principle of integration by which it joined with other departments in the purchase of comparatively expensive equipment which could not be furnished to a single department; such as the original electrocardiograph with medicine, the moving picture apparatus with the extension division, the harmonic analyzer with physics, tone generators with engineering, correlation machines with education, and other instruments held by the graduate college for the service of any department that might need them. Thus in a single year the laboratory might have access to a new instrument which cost more than the entire regular budget to the department for the year.

To the budget just mentioned should be added the salaries paid to

the head mechanician in the physics-psychology shop, the electrical engineer employed on full time and often with an assistant for the central laboratory and its various services, and the research students who often spend much of their time in building their own apparatus.

It has been the policy of the department not to put money into so-called "standard" or "show" pieces but to concentrate upon the development of new equipment to meet new needs for each incoming group of research students. For this reason a large part of the apparatus has been of such a nature that it has served a specific purpose when a particular investigation was going on and was often later converted or dismantled in its adaptation for other purposes. Because of this we have always had difficulty in maintaining a significant annual inventory. One year a synchronous motor is in one instrument; another year it may be in another. This is especially characteristic of the numerous vacuum-tube units and graphic and photographic recording devices which can be used for a great variety of purposes. Many of the instruments are not built in a permanent form but are set up temporarily for their immediate use. In view of these facts there is not much significance attached to any valuation of the laboratory in dollars and cents because practically the whole equipment is in a fluid state of functional allocations in the central laboratory and its extensions.

One principle which has always given great satisfaction is the pleasure in scrapping an instrument; because we rarely scrap one except for the reason that we have secured a better one. Such scrapping is one of the expensive aspects of research work that has been well illustrated, for example, in recent years in transmitters and amplifiers in acoustics. New models are continually coming out and frequently have radical improvements. Fortunately a lowering of the commercial price of the instrument usually goes with this.

The modern student can hardly realize the phenomenal advantage he has over the early workers in psychology. In the laboratory today the incoming research student is given access to working models of research equipment ready for use; whereas in the early stages, the psychologist was like the maid who saved the house from burning and explained that she had had no education and therefore had to use her brains and hands. This does not imply that there is no need for the same attitude at present; indeed, with the increasing new avenues of approach, there is more and more demand for the inventive mind with ingenuity in the adaptation and design of equipment at the level of rich existing resources.

While the equipment of the original central laboratory has always been available to workers in all fields of psychological or acoustical research in the University, individual laboratories have developed with equipment to meet extensive specific needs. Such are the child welfare laboratories, and the laboratories of the Psychopathic Hospital, the speech department, the department of neurophysiology, and the department of otology.

In addition to the equipment in the laboratory, acknowledgment must be given to the privileges which psychology has had for utilizing existing equipment in related scientific laboratories and institutions. In return, the laboratory has contributed through its inventive resources to the enrichment of equipment in such laboratories. The laboratory has enjoyed cordial relations with commercial laboratories, such as the Bell Telephone Laboratories, and it has often been enriched through generous contributions from them. A new demand for mental or motor measurements on man and animal usually arises as a psychological problem. This must first be met in the psychological laboratory, and then as soon as a particular instrument, such as an audiometer, eye-movement camera, or psychophysical recording device is fairly developed, it is shared and passed on into a great variety of services.

BUILDINGS

Coming out of the single room which Patrick had in the administration building, the laboratory developed for four years in a five-room accommodation at 14 North Clinton Street. During that period the new hall of liberal arts, where generous provision was made for psychology, was built. The space allotted varied from twelve to fifteen rooms which, however, very soon proved inadequate accommodation for the large number of research projects in operation.

One outstanding feature of this suite was the sound- light- and jar-proof room which was built up from a special foundation below the basement in a tunnel reaching to the attic with a special room opening on the second floor.[8] I spent my first summer vacation in Iowa City supervising the construction of this room. So far as I know, this was the only sound- light- and jar-proof room of its kind in existence at that time. All communication with this room was through electrical devices from an adjoining anteroom. This room, without solid contact with any part of the main building, was something of an extravagance

8 Patrick, George T. W.: The new psychological laboratory at the University of Iowa. Univ. of Iowa Stud. in Psychol., 1902, 3, 140-144.

in the cost of construction, being built on the principle of a gigantic thermos bottle standing on a towering support of sand piers. Entrance was gained to the room by passing through four successive doors, none of which had any lock but was opened by springs as a safeguard for any occupant who might be caught in this room in the dark and be without power of communication with the outside. One of the misfortunes of moving the laboratory to its present quarters was the necessity of sacrificing this room.*

Congestion in this suite in the liberal arts building was greatly relieved by placing a large unit of clinical psychology in the Psychopathic Hospital and by the increasing facilities of the Iowa Child Welfare Research Station.

In 1929, the psychological laboratory had the great fortune to join with education, philosophy, and child welfare in taking over the old central University Hospital which had some 300 rooms.** This building, which is now named East Hall, is a straggling building; six stories high in one wing and seven in the other, with a connecting middle section of four stories. It is well equipped with stairways and elevators, and most of it is of fireproof construction. Its general structure could not have been better designed for this new purpose in that the private rooms furnished suitable offices, laboratories and workshops, and the wards provided lecture rooms without any considerable change of the walls or other basic structure. The state appropriated an ample amount for renovating and thoroughly equipping the building, covering electrical communication systems, supply services, and adequate furniture for each room.

A brief description of this laboratory was published by Ruckmick.[9] The illustrations here given are taken from the program published at the dedication of the laboratory, December 30, 1930. Figure 1 shows an outside view of the main part of the building; Figures 2 to 6 give the ground plan. Some redistribution of the rooms has been made in recent years, but the general plan of accommodations remains.

* The exclusion of sound from the outside intensified sounds in the room, such as the creaking of a coat sleeve, breathing, and minor reflexes, which in an ordinary room would remain unnoticed. One student even reported that he could hear the creaking of his backbone.

** This hospital had been standing idle for two years when one day I asked President Jessup what he was going to do with it. He said, "Well, that is an elephant on our hands," to which I replied, "Let us have it." He said, "All right," and I said, "Thank you, good morning," grabbed my hat and walked out to avoid the introduction of any qualifications. In about ten days Dean Packer and I took him a plan for the utilization of the building which was approved, I am sure, to the great advantage of the University as a whole. It was named East Hall because of its location on the campus.

9 Ruckmick, Christian A.: The psychological laboratory at the University of Iowa. J. Exper. Psychol., 21, No. 6, 1937, 687-697.

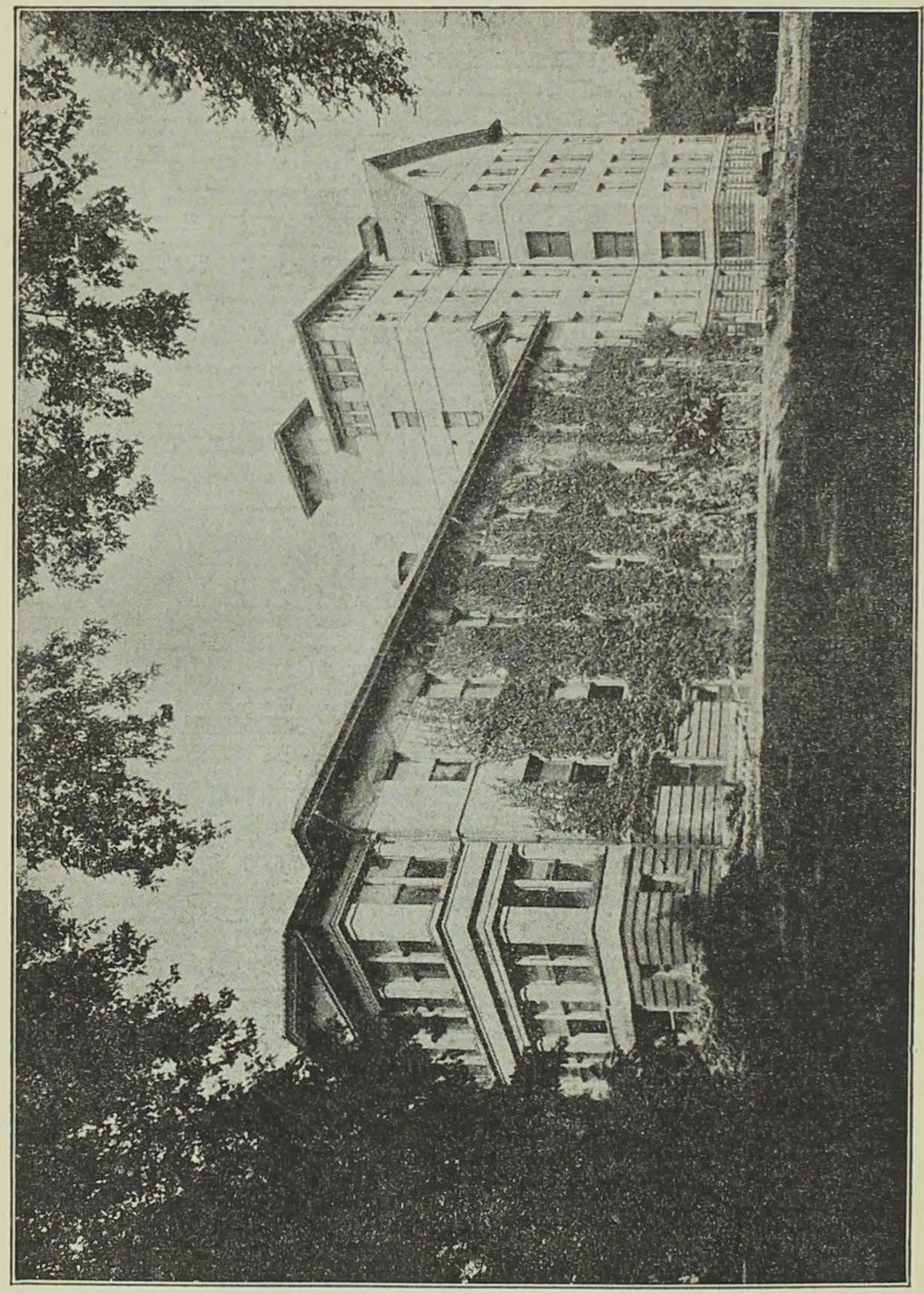

Fig. 1. Southeast view of the laboratory

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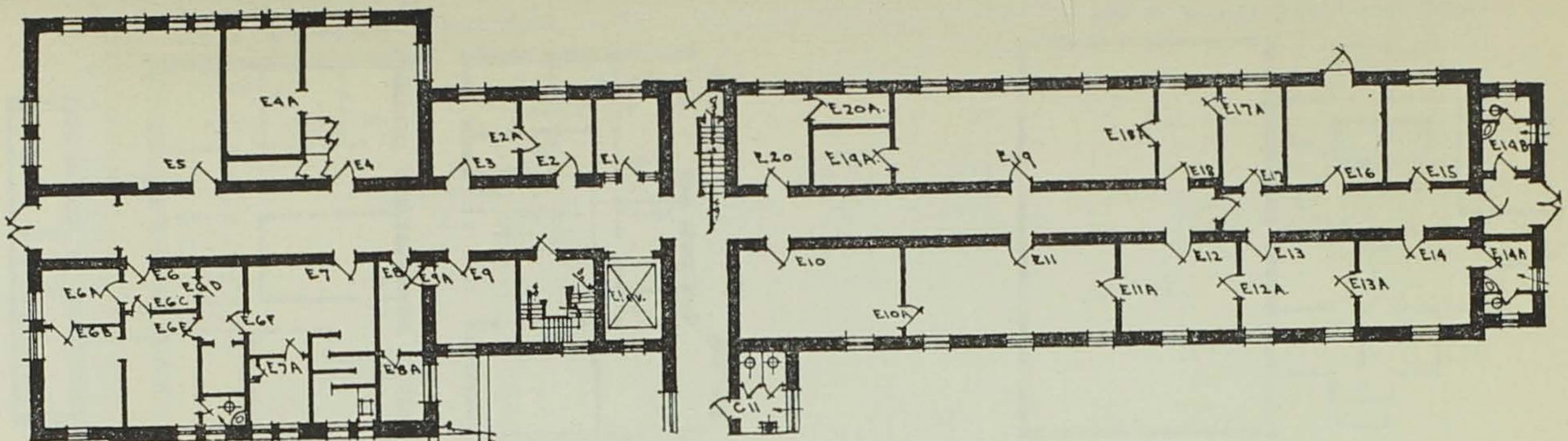

Fig. 2. Ground floor, east wing

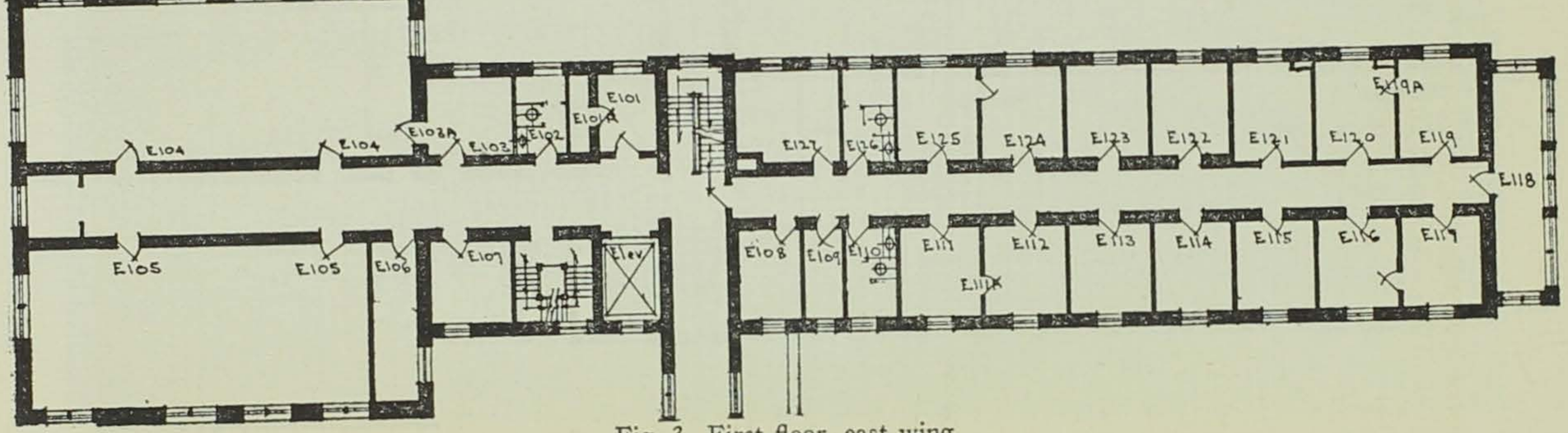

Fig. 3. First floor, east wing

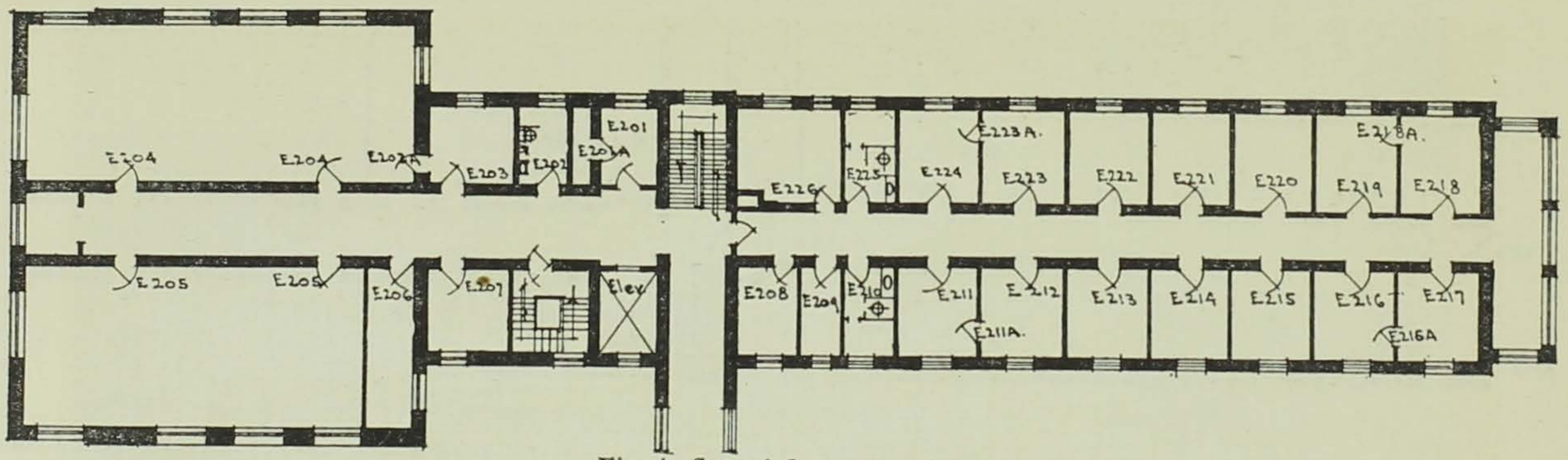

Fig. 4. Second floor, east wing

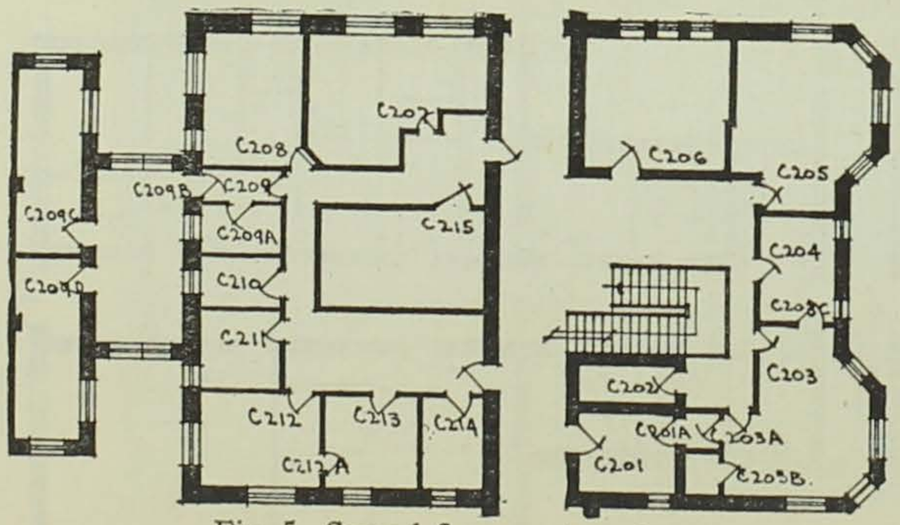

Fig. 5. Second floor, center wing

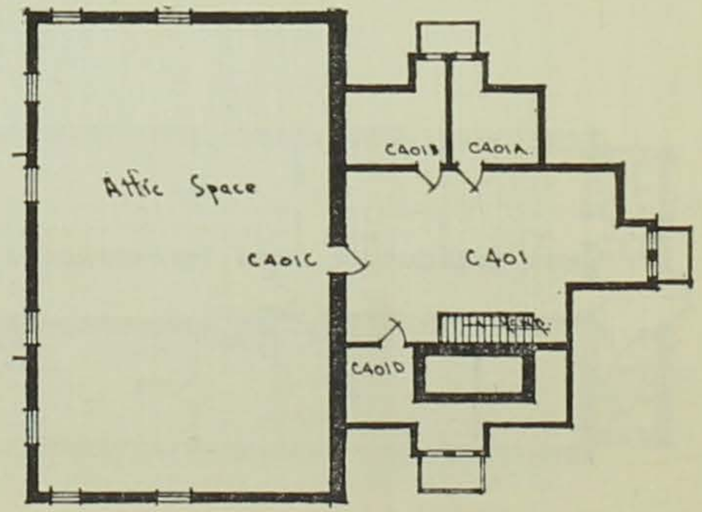

Fig. 6. Fourth floor, center wing

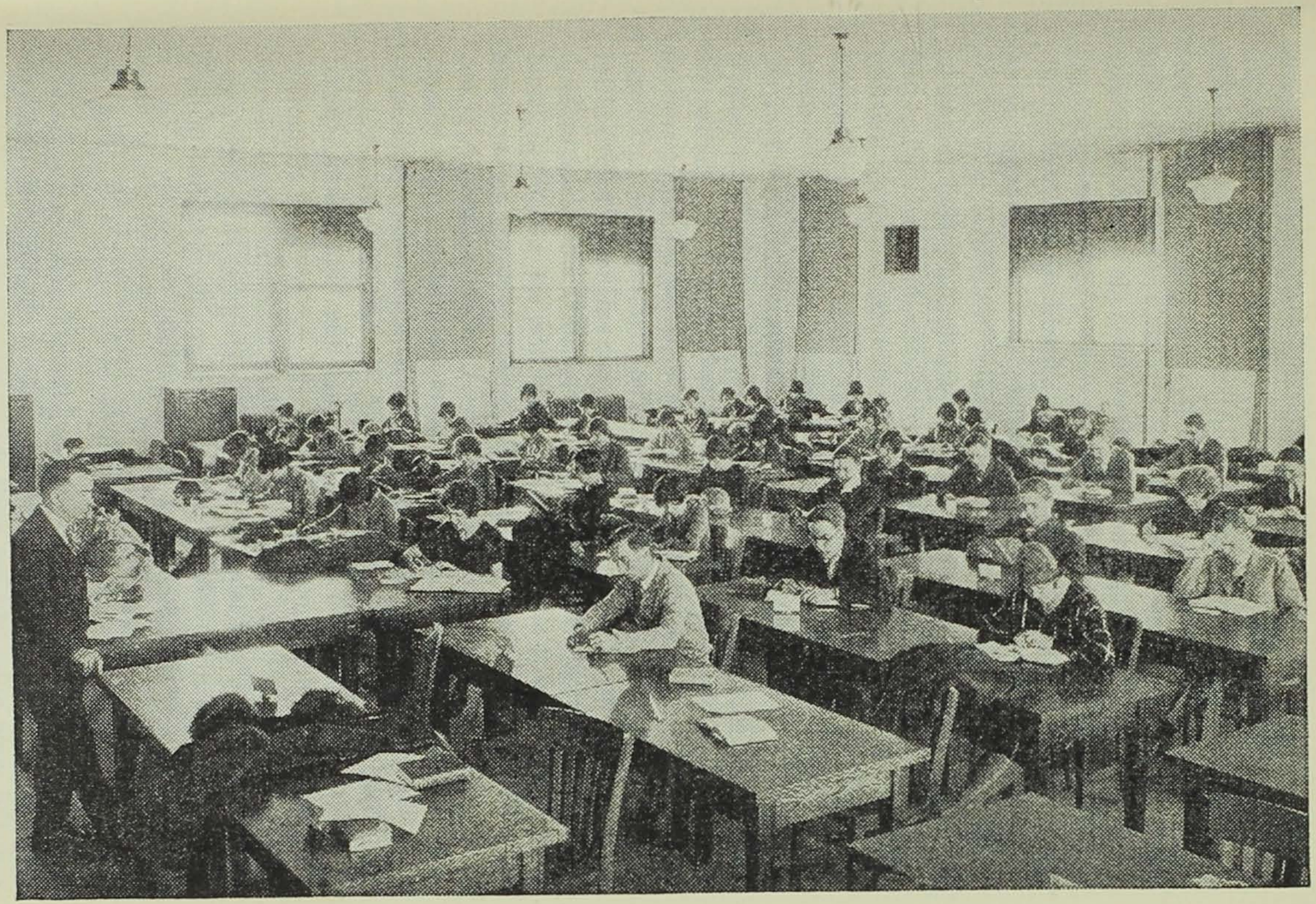

Fig. 7. A corner of the project room for elementary psychology. See Ch. X, p. 207.

The psychological laboratory occupies the major part of the east wing and a part of the central section. In all, there are about 75 rooms available for the department. All the departments housed in East Hall have a departmental library in common, located in the west wing. Each department has adequate study space in a room adjoining the library so that the graduate students who do not have private rooms may have individual desks. Child welfare and psychology have co-operated with education in equipping a machine room in the basement of the west wing in which first-class machine equipment is installed and is available for all the departments in the building.

The adequacy of facilities for psychology in East Hall should be judged in the light of supplementary facilities in this building and outside. Child welfare occupies a suite of forty rooms on the fifth and sixth floors of the west wing, together with four small individual buildings in which work is devoted to preschool training and research. The facilities for the study of infant behavior are continued in the lying-in unit of the University Hospital, which furnishes ample facilities for this type of psychological approach. The best facilities for genetic studies of the psychology of art are found in the university preschool and the first twelve grades. The psychology of art laboratory, which occupies seven rooms on the second floor of the central section of East Hall, maintains close co-operation with child welfare, graphic and plastic arts, journalism, and the art section in home economics. Facilities for the studies of animal behavior are available in medicine, child welfare, and zoology. A phonetics laboratory and the acoustical laboratory are operated jointly with speech. The laboratories for educational psychology are located in the rooms allotted to the college of education in the west wing. In addition to the experimental schools from the preschool through the high school, special laboratories are maintained in education in the fields of arithmetic, reading, mental testing, and statistics. The accommodations in the physics laboratory and in the Psychopathic Hospital have been mentioned. Later mention will be made of the specially designed project room for elementary courses in University Hall.

PUBLICATIONS

The first volume of the *University of Iowa Studies in Psychology* appeared in 1897, and these *Studies* have been continued in principle with the same point of view until there are now more than twenty volumes in that series. The first three volumes were edited by Patrick.

Later volumes were edited by the writer, until 1927, when Ruckmick undertook the general editorship, and later shared editorial responsibility with Miles and Starch, Travis, Meier, and Tiffin, in their respective fields. Beginning with Volume IV, these *Studies* have been published as a unit in the *Psychological Monograph Series* under the editorial control of the *Psychological Review.* Later, the *University of Iowa Studies in the Psychology of Music* [10] were established.

Psychological publications from the Iowa Child Welfare Research Station furnish an unparalleled output from a single institution in the field of genetic research. The *Archives of Speech*, emanating from the psychological laboratory under the editorship of the department of speech, have furnished a good channel for publication in that specific field. The tendency is more and more to utilize outlets for publication in standard journals in psychology and such related journals as *The Journal of the Acoustical Society of America, The Archives of Otology, Speech Monographs*, and certain other channels devoted to the psychological laboratory.

In all of these publications, the attitude of the laboratory has been to maintain the policy of expecting the director of each piece of research to throw his best energies into the development of it, exercise rigid control over the final manuscript for publication, and then let the student sign his name to it. This is in contrast to the policy of joint publication by professor and student. Often the director of research has had the problem well formulated in advance, has helped design the apparatus, has served as an observer, and has exercised a strong editorial hand in the writing. I am convinced that this has safeguarded the publications from the laboratory and has been a source of encouragement to students in research without any loss to the instructors.*

THE STAFF

It would be a delightful privilege to give an account here of the contributors to the building of the Iowa laboratory, but that would be a

10 *University of Iowa Studies in the Psychology of Music*, Volumes I to IV, inclusive. Iowa City, Iowa: University of Iowa Press. Volume I, the vibrato, 1932, Pp. 382; Volume II, Measurement of musical talent, 1935, Pp. 144; Volume III, Psychology of the vibrato in voice and instrument, 1936, Pp. 159; Volume IV, Objective analysis of musical performance, 1937, Pp. 379.

* I regret to say that the tendency is for the opposite policy to crop out in current institutions elsewhere. There are, of course, certain cases representing special rights when a notable discovery or invention by the instructor is first announced through the publication; but even then it would be better for him to make a separate announcement under his own name in establishing priority.

large undertaking and space does not permit it. Starting from the very humblest beginning, the staff has grown and differentiated in functions on a large scale. Because of the prevailing type of integration with other departments discussed earlier, it is difficult to say how many psychologists there are on the staff at any given time. It would be easier to recognize divisions of labor; such as systematic, clinical, educational, and genetic psychology, and others.

But the question at once arises: How many of the psychologists in child welfare, how many psychiatrists in the Psychopathic Hospital, how many specialists in half a dozen branches of the psychology of acoustics, how many of the educationists dealing with tests and measurements shall we count as members of the staff? Students have access to all of them; most of them have shared in the building and conduct of the department; and all of them operate more or less directly from the central laboratory in their advanced work. All have shared more or less in the spirit of pioneering. Each member has been free to expand in his own direction. Each member of the staff who has contributed generously toward fundamental principles in psychology or the development of new avenues of approach must speak for himself through the publications he has inspired and the present leadership which he holds. It is significant that national leadership has been obtained in both pure and applied psychology, but it is too early and too personal a matter to attempt to evaluate the permanent significance of these contributions.

As one who has shared their companionship and co-operation for so many years, I can only express my profound personal obligations and the very great debt of the University to those whose lives have been cast in psychology as a life work at the University of Iowa.

GRADUATE DEGREES GRANTED

The following is a list of the graduate degrees granted in psychology from 1900-1937.

Year	Number				
	M.A.	Ph.D			
1902-1903	1	1	1912-1913	0	2
1903-1904	3	0	1913-1914	4	0
1905-1906	0	1	1914-1915	3	1
1906-1907	2	0	1915-1916	1	1
1908-1909	1	0	1916-1917	3	0
1909-1910	3	0	1917-1918	1	2
1910-1911	1	0	1918-1919	1	1
1911-1912	1	1	1919-1920	4	1

1920-1921	0	4	1929-1930	13	7
1921-1922	5	4	1930-1931	15	4
1922-1923	6	3	1931-1932	10	8
1923-1924	4	2	1932-1933	14	17
1924-1925	11	3	1933-1934	5	11
1925-1926	5	10	1934-1935	11	7
1926-1927	4	8	1935-1936	8	16
1927-1928	7	5	1936-1937	12	9
1928-1929	8	8			
			Total	167	137

This list of those who have gained advanced degrees through registration for psychology as a major subject might properly be augmented by a list of those who have majored in allied departments but have worked in distinctly psychological fields; notably, in the psychology of the child, educational psychology, psychology of speech, philosophy and psychiatry.

DEDICATION OF THE LABORATORY

The laboratory in East Hall was dedicated December 30, 1930. At that time the following addresses were given:

Systematic Psychology
Professor Howard Crosby Warren
Other Natural Sciences
Professor Walter R. Miles
Education
Professor Charles H. Judd
Psychiatry
Professor Edward A. Bott
Psychotechnology
Professor Robert S. Woodworth

The following motto of the department was engrossed and unveiled:

Insight into the Nature of Mental Life,
Appreciation of its Beauty, and
Wisdom in its Control
Development of Personality, Scientific Integrity,
and the Art of Deliberate and Adequate
Statement of Fact
Center for Fundamental Science and
Service to Mankind
Memorial to the Pioneers in Psychology
Hearth for Comrades in Research
To these Ends this Laboratory is Solemnly
Dedicated for the Commonwealth of Iowa

Chapter III

THE BUILDING OF INSTRUMENTS

The Iowa policy in regard to the choice of topics for research by advanced graduate students is unique. When a student comes in to select a subject, he has probably gone the rounds and found out what fields of concentration are being pursued in the department. Unless he brings an unusually good subject from outside of these developments, he is encouraged to select his topic in a field in which the professor in charge has good command of the experimental situation in regard to the problem involved, the series of preceding researches in this field, the equipment, and the definition of objectives. The advantage of this to the incoming student is that he will at once have teamwork with the professor, together with the investigating students who have preceded him and are associated with him in this field. It aids the student in his orientation and creates a feeling of solidarity among the students in the department. The advantage to the professor is that he can build up a co-operative group of investigators for the logical pursuit of a specific project throughout a period of years, fractionating the issues in a logical development. This policy is a great time-saver, enabling us to have as many as ten or twenty researches pursued at natural stages in the development of a single problem. The laboratory specializes in research through the division of labor with other laboratories in that it assumes leadership on specific issues and avoids duplication. This policy affects the procedure in building apparatus by making it possible to keep the laboratory well equipped along the few lines which are pursued and make revision and additions to apparatus on a long-time program in opening up new fields of investigation.

To illustrate some of the problems involved in the construction of instruments for a new field, let me touch briefly upon the situations involved in particular lines of the development of some instruments in the field of psychological acoustics. The experiences with these instruments illustrate some of the problems, the hazards, the modes of using available resources, the dependence upon advances of other sciences, the necessity of grasping opportunities as they come, and the

discovery of a constituency of users, both in the laboratory and in the larger community to be served. My purpose is to reveal some of the situations that confront one in pioneering at psychological frontiers. Numerous other instrumental situations could have been chosen, but I think the following five are typical.

AUDIOMETERS

Eyes have been tested for ages for the purpose of corrective treatment with glasses and other remedial means; but when my interest was first drawn to the study of hearing, it was a virgin field. The methods employed by physicians were exceedingly primitive, the medium most frequently used being the watch test or the whisper test. Tuning forks were occasionally used but without competent technique. Nothing had been done in the schools.

In the '90's, Scripture pointed out this fact and put out a small audiometer through Stoelting. I worked with this and found that it was not well adapted for the purpose. Therefore, the first problem I tackled after coming to Iowa was that of designing an audiometer suitable for use both in the laboratory and in the schools. After considerable experimenting, I built this first audiometer with my own hands. It was long after this that the term "decibel" was coined, but it was interesting that in this rule-of-thumb procedure I had hit upon the approximate present decibel magnitude as a unit in forty steps and had made it linear through the choice of a fitting logarithmic scale of intensities.

Of course, this early model had many drawbacks, one being that it employed the ordinary telephone receiver, which could not be kept at a standard, and another that it was limited to the few pitch levels for which we could sample different pitch levels by putting tuning forks in the circuit.

This audiometer was taken over by Stoelting about 1900; and for about fifteen years it was the only audiometer on the market aside from Scripture's original model.* Then about 1915 we undertook a series of experiments in building audiometers on an entirely different principle with the object of securing test stimuli for a continuous pitch series throughout the auditory range. We built perhaps six or eight different models with this in view and reached a notable achieve-

* Stoelting has sold a large number of these audiometers; but in order to encourage his pioneering in the building of psychological instruments, I have refused to accept any royalty either for this or other instruments of mine marketed by him. Being a scientific instrument, it was not patented.

ment in what became known as the Iowa Pitch Range Audiometer.[11]

In the construction of the pitch range audiometer, we had the very valuable assistance of the late Dr. C. F. Lorenz, then instructor in physics. We were also materially aided by the co-operation of Dr. Dean in the department of otology and his research assistant, Dr. Bunch. It is interesting to note that the principal difficulty we encountered was that of securing a constant speed control. At that time there were no constant speed motors suitable for this purpose on the market and the alternating current supply was not constant. Therefore a very large part of our expenses and efforts went into the building of a synchronous motor. It has been one of the hardships of psychology that we have been forced to spend much energy outside of psychology proper in meeting that type of situation, especially because psychologists are not competent physicists to deal adequately with the problem of invention of instruments. However, they must have instruments to do the work and so they do the best they can.

Up to this time I had had several occasions to urge the Bell Telephone Company to take cognizance of this problem and go into it on a large scale of scientific investigation. I finally reached the sympathetic ear of Vice-President Jewett. I think the reason for his responding at that time was the fact that the vacuum-tube technique had just come into general use in tone production and control, and he saw the possibilities of this new approach. It is also significant to note that this was at the beginning of the policy of this great institution, the Bell Telephone Company, to go extensively into pure research. At the present time that research unit is perhaps without parallel among industrial institutions in its contributions to fundamental science of acoustics.

It was reported that during the first year of experimentation the Bell Laboratories spent over $200,000 on the construction of the audiometer A-1. The building of this audiometer was a notable achievement. In recognition of my pioneering work, they presented Iowa with one of the first models which I think was at that time listed at $800. My pitch range audiometer had just gained recognition in the otological journals, but I immediately called attention to the fact that the new vacuum-tube audiometer presented a superior solution except in one respect; and on this — the importance of having stimuli in a continuous series from the highest to the lowest pitch

11 Bunch, C. C.: The measurements of hearing throughout the tonal range. Univ. of Iowa Stud. in Psychol., 1922, 8, 45-82.

usable — we had considerable controversy in the journals for a few years. But this contention has gradually been recognized by builders of audiometers in recent years and suitable provisions have been made for it.

After having built all of these models and prepared them for market it was rather interesting that I should take satisfaction in saying that the Iowa Pitch Range Audiometer would not go on the market. Yet its main objective had been attained; namely, that of creating a recognition for the possibilities and the significance of audiometers, both theoretical and practical.*

As a souvenir of the co-operative relations between the University and the Bell Telephone Company, Vice-President Jewett had me stand with him for a picture by the side of their new audiometer. This was published in the Bell Telephone bulletin under the legend, "The original audiometer man."

I first used this instrument in a series of tests on school children in 1899.[12] In 1933 I bought with graduate research funds a Western Electric A-4 Audiometer for the purpose of loaning it to organizations which wanted to introduce hearing tests in the public schools of Iowa, and in 1936 this project was enlarged by placing Dr. Gardner at the service of the state with this audiometer. For two years he did notably successful pioneer work in this field. I think this was the first state undertaking of the kind. The project was made entirely self-sustaining in that superintendents who wished to have their pupils examined could invite Dr. Gardner for such time as was necessary on the payment of a moderate sum *per diem*.** Since that time several

* For early history of audiometry, see Bunch, C.C., The development of the audiometer, Laryngoscope, 1941, 51, 1100-1118.

12 Suggestions for Tests on School Children. *Educ. Review*, 1901, *22*, 69-82.

** It is interesting to find that for very good reasons the department of otology in the State University Hospital could not sponsor this movement because it would immediately have been interpreted as proselyting for patients. Not even the extension division, representing the board of education, dared to sponsor the subject for the same reason. Nor did we feel safe in designating the service as official from the psychological clinic. To get around these difficulties, I simply issued a bulletin to city superintendents of the state describing the necessity for the work, the methods of procedure, and some of its significant features, purely as a personal note, introducing the specialist in this field who had been trained for this work in our laboratories but who could not be regarded as a member of our staff. This is a rather striking example of how careful the University has to be about treading upon the area of professional services.

It is also a striking example of the necessity of educating a profession to a new point of view. When Dr. Gardner came into the field, his first step was to call upon the school physician and other physicians who might be interested, explaining that his services would neither prescribe nor treat but he would expect the cases discovered to be referred to physicians. So far as I have been able to learn, no objection to this procedure was raised by any physician throughout this experiment.

It is also interesting to note that after three years of operation, the state board of

states have introduced projects of the same kind, the object being to demonstrate the significance of hearing tests and encourage school systems to purchase their own audiometers and employ a trained tester.

It is a notable fact that our experimental work in the development of audiometry led to the recognition of an entirely new type of medical service; namely, that of psychologist in otology. Dr. Bunch, who had been trained in this laboratory, working under the direction of Dr. Dean and myself, was the first man in this country to be recognized in that capacity. He was followed in the Iowa hospital by Dr. Scott N. Reger, who was trained in the psychology of music but switched over to this field when a vacancy occurred in otology. It is a great satisfaction to observe the large number of scientific and practical contributions that he has made in the otological service and that he has demonstrated the wisdom, if not the necessity, of maintaining a psychologist in hearing in every significant otological service, both for research and for routine services. Thus, out of the invention of the audiometer came the launching of a new profession, that of psychologist in otology, which is rapidly being recognized.

During World War I, physicians who had to certify normality of hearing in recruits, found themselves without any adequate instruments for the measuring of acuity of hearing. They fumbled along with the whispering test, the watch test and tuning forks with the result that there were grave sources of error in their certifications for the intake. When the volunteers returned and for many years after their return in cases of application for disabilities, the authorities were in a position to make much more accurate measurements, often showing a degree of loss of hearing which had, of necessity, to be attributed to the hardships of the War service and therefore led to pensions. Had equally adequate measurements been made on the intake, showing whether or not they were pre-war conditions, that would have saved this country very large sums of money. It remains to be seen to what extent the selective service in War II has profited by this lesson.

Acting as chairman of the committee on acoustic problems in the National Research Council during World War I, I started a movement to design and provide a simple audiometer for the principal

education passed a rule that this service should be discontinued, apparently on the ground that too many cases of imperfect hearing would be discovered in the schools. But that edict came too late; the experiment had already served its purpose, and the schools are now introducing audiometry with their own instruments and on their own initiative.

receiving centers. I built a dozen of these and placed them for trial in the hands of competent examiners, but nothing came of it because we had reached that stage just at the time of the armistice.

It is gratifying to find now that owing to the extraordinary developments in the field of audiometry within the last twenty years, the medical profession is being provided with the means and facilities for analyzing hearing defects and fitting hearing aids, working on the analogy of procedure in ophthalmology. Unfortunately it takes a long time for physicians to recognize these new possibilities and responsibilities. The result is that much of this service is in the hands of commercial interests rather than in the hands of the medical profession. On the other hand, it is gratifying to find that current research on hearing-loss is rapidly building a significant unit of science in that field of acoustics and making rapid strides of progress in the theory of hearing from the point of view of fundamental physiological and psychological sciences as well as for remedial purposes.

TONOSCOPES

One of the first demands in our equipment for the psychology of music was for an instrument which would enable us to see ourselves sing or play in terms of all aspects of pitch; such as attack, release, and the sustaining of a tone, regarding conformity to true pitch and the possibility of artistic deviations from true pitch, each essential to the art of music. The original instrument for this purpose was the tonoscope which converted the vibrations of sound into visual pictures so that the moment you sang or played a tone you could see instantly the degree of success or failure.*

In 1893 Scripture conceived the idea of building a tonoscope on the principle of stroboscopic vision and I collaborated with him. In Iowa this conception went through a series of stages and we built one model after another; first, in the direction of making it adequate however costly, and then in the direction of simplifying models, taking advantage of new resources coming in from time to time. The idea was that when playing or singing a tone, the exact pitch intonation should be exhibited visually for the duration of the tone within accuracies of from .10 to .01 of a whole tone step, the degree of precision depending upon the steadiness of the registering tone.

Historically, it is of interest to note that at various stages we were

* See Chapter IV for problems.

delayed by the absence of accessory instruments in physics, essential for the construction of this instrument. Thus for the purpose of illumination, we started with a monometric flame using common illuminating gas. Then came carbide gas which was much more efficient but dangerous. Then came the vacuum-tube and in that series, a variety of improvements in vacuum-tube techniques, especially in the refinement of the microphone and the amplifying system. Likewise, in the matter of speed control of the tonoscope we started by controlling it approximately with a direct current motor, having an observer watch and guard against significant deviation from constant speed on the principle of stroboscopic vision.

So, in co-operation with physicists we began to design synchronous motors to drive the tonoscope, and in that, there followed a series of developments dependent upon progress made in physics. Now that the city light circuit is controlled at constant speed and we have alternating current motors, the process is simplified and the problem of speed control is solved. It is difficult to realize how great an amount of work was put into the building of such an instrument.

But we encountered another problem, unique for this instrument, namely, that of creating a demand for it in the musical constituency for which it was ultimately aimed. The tonoscope in its various models stood alone in this field and was available for the original purposes for which it was designed, but the constituency of users remained conspicuously absent for nearly forty years. It took some courage to continue the effort to create a constituency; but in the last few years gratifying progress has been made in that respect.

Music teachers today are in a position analogous to that of the otologist a generation or two ago who had but few and insignificant instruments for exact and convenient measurement of the character and loss of hearing, function of the vocal cords, and location of lesions. Today the up-to-date otologist's office is equipped with audiometers, oral cameras, X-ray cameras, and fluoroscopes. So the progressive music teacher of the near future will be equipped with up-to-date instruments for quick and accurate measurement of the four elements of tone, of which the measurement of pitch is the first to attract attention. Thus we paved the way for the development of a new feature in teacher-training institutions; namely, the use of instruments in the development of musical skills, and our original goal has been reached. There are now on the market a variety of tonoscopes built on the most recently developed electrical principles of stroboscopic control

and my *Measurement of Pitch Intonation with the Tonoscope in Singing and Playing* [13] is coming into use as a manual.

TONE GENERATORS

A graduate engineering student who had been discouraged because he had no money to finance himself came to see me about registering for graduate work. The electrical engineers did not encourage the project about which he had some ambitious convictions; namely, the building of an electrical organ. After careful analysis of his plans and an evaluation of his ability, it was agreed that he should take about three years to build a single note according to his specifications, the time to be spent on the construction of a tone generator representing one key of the organ and an experimental study of the possibilities for the control and enrichment of the tone produced by it. He was assured that if he would build this generator for the psychological laboratory under the joint direction of engineers and psychologists and let it become the property of the laboratory, he could be guaranteed all the facilities of the workshops in psychology and engineering, supply of all needed material, and probably a graduate stipend for that period. This "contract" proved very advantageous to psychology in that it not only gave us a new type of instrument capable of meeting new situations in psychology but also represented a very great saving in the cost of construction.

This was far from building an organ, but it proved a notable undertaking, which was completed with great distinction. The electrostatic tone-generator consists of sixteen partials, the equivalent of sixteen pure tones, any number of which may be combined into a rich tone of harmonic structure. It has the possibility of varying the basic pitch, the number of partials, the amount of energy in each partial, and the phase relations of each partial. Mathematicians assure us that with sixteen units, each with so many variables, we can produce more than a million varieties of tonal timbre.

No such enormous number of tone qualities can have practical significance in music or experimental work in acoustics and phonetics. To simplify the situation, we select as many types and degrees of qualitative difference in tone as may be significant for actual music or for an experimental situation. The setting for each pattern is wired to a keyboard like an organ console so that the different qual-

[13] Univ. of Iowa Stud., Aims and Progress of Research, First Series, No. 172, 1930.

ities of the same note can be played as on the organ by merely pressing the appropriate key. While a musician can hear a large number of differences in tonal timbre experimentally, in practical music he probably does not intentionally employ more than twenty or thirty varieties. These connections, for experimental purposes, are made with a stencil like the stencil on a player piano which, when run through at an even speed, will play selected patterns exactly timed.

With this generator, it is possible to take the harmonic analysis of any desired tone and reproduce the tone synthetically in so far as it is covered by the first sixteen partials. To make sure that this reconstruction is accurate, we have only to make harmonic analysis of the artificial tone and compare that with the specifications from the original tone.

One can readily see what a wide range of opportunities for experiment the presence of such an instrument provides in the laboratory. There are many kinds of tone generators on the market; but I think it has been generally agreed that at the time of its construction, this one combined the best features of all and had several new features.

One superior feature of this apparatus is that one can set up any representative series of tone-qualities of harmonic structure for the purpose of experimentation. Thus we can make it speak any of the basic vowels or their variants in so far as they are composed of harmonic structure within the range here covered; we can take the harmonic analysis of the performance of an artist in voice or instrument and reconstruct it synthetically; we can set up scales for the measurement of a sense of timbre; we can set up hundreds of varieties of specific experimental controls for the detailed study of specific issues involved in tone-quality; and, strange as it may seem, we can not only set up a tone according to quantitative and qualitative specifications, but we can define, verify, describe, and reproduce each and all of such tones with precision.

This sounds a little like magic, but it helps take concepts of timbre and sonance out of the prevailing chaos. We can humbly say that within reasonable limits it makes us masters of this most complicated and important element in tone production, the quality of the tone. This principle is, of course, fundamental for the incoming avalanche of electronic musical instruments.

To accomplish this invention a mastery of principles of electrical engineering was essential. This was supervised by the head of the electrical engineering department. Of equally vital importance was a

critical knowledge of the composition and function of elements of musical sounds from the point of music and acoustics. This was supervised by Dr. Don Lewis, who was specializing in studies of timbre in the department of psychology. The student-inventor himself had the necessary ingenuity and drive. Result: he obtained ideal training in research, and the laboratory was enriched through the possession of a rare and exceedingly valuable instrument.

PHONOPHOTOGRAPHIC CAMERAS

The principle that each new scientific venture is dependent upon achievements in other sciences is again well illustrated in the case of phonophotography. We who are interested in measurement in the field of acoustics have watched with an eager eye the simple beginnings and the long series of improvements, step by step, in the means of securing adequate photographing and analysis of sound waves for the purpose of measurement.

Proceeding from kymographic techniques and recording with optical levers, we fell in line with the incoming practice of photographing on motion picture films — a movement which proceeded with extraordinary strides in the great industries concerned with the recording and transmission of music. The project has become one of great financial interest among instrument makers, and the very best engineering talent has been directed to the solution of problems involved. Among these problems was the development of fidelity of the microphone. Early commercial products, both in phonograph and radio, began with very crude instruments; but competition among instrument makers and specialists in acoustics has resulted in a remarkably rapid improvement, mostly by successive advances in specific features, so that today we have satisfactory linear response and adequate range of response in microphones.

Parallel with this came the development of systems of optical levers and amplifiers with special adaptation for particular purposes. Then followed, of necessity, the development of better and better film material and specialization in types of films for particular purposes. With these advances came the problem of the recording studio.

Nearly all these features came from the great commercial interests; but in the psychological laboratory we were confronted with highly specific problems in measurement for purely scientific purposes, and we had to keep in touch with the commercial improvements, making adaptations to meet the specific needs of the laboratory. Most of this

work in the laboratory was in the line of electrical engineering in psychology. The result was that we required the services of one or more acoustical engineers to design, adapt, and condition electrical outfits. All this proved expensive, but the principle on which we worked was that the best obtainable is none too good.

Fortunately, these expenditures have proved highly justified by the demonstration of adequate approaches in new avenues of research in pure as well as in applied psychology so that it may be safely said that when psychology in acoustics goes into full swing, we may look for results which are as wide in range and as significant as are the extraordinary developments in the commercial recording and transmission of sound. The first advances are, of necessity, purely physical. The harvest comes in the adequate solution of problems in science and art.

To give an example of the psychological use of makeshifts, Metfessel developed a very simple camera using an optical lever on moving picture film for the recording of primitive music. The camera was camouflaged in a suitcase and we went among the untutored Negroes at work in the South, recording their singing, the camera being adequate for our purposes of pitch and time recording. The impression given to the Negroes was that the camera in the suitcase was taking moving pictures while they were singing, which was true; but nothing was said about the recording of the song. In this way about thirty songs of the primitive Negro singers were recorded and the songs were analyzed and published.[14] The single and specific objective here pursued was the adequate photographing of music. The numerous paths and by-paths pursued for the development of facilities for this in the laboratory are illustrated in the publications on various aspects of phonophotography in music and speech emanating from the laboratory.

THE PIANO CAMERA

Ensemble playing or performance on an instrument such as the piano, in which a large factor is the harmony, is not suitable for recording and measuring the types just described because the oscillogram obtained is too complex for most analytical purposes. To solve this problem for the piano, we made preliminary analyses and verified the fact that whereas the singer and the violinist, for example, have the four elements of the tone under their control, the pianist has only two (except in the use of the pedal); namely, the temporal and the

14 Metfessel, Milton: Phonophotography in folk-music. Chapel Hill: University of North Carolina Press, 1928, Pp. 181.

dynamic. The pitch is indicated by the score and is not under control of the player except in striking the right key, and the timbre is controlled by the individual character of the piano as an instrument and is conditioned by the intensity of the tone.

It is generally believed among musicians that the tone-quality can be controlled directly by highly organized forms of movement of arm, wrist, and fingers in piano touch, but we now find that the only way in which the pianist can control tone-quality except in the use of the pedals, is through the force of the blow of the hammer at the moment that it strikes the string; that is, through the intensity of the tone. The musician rightly thinks in terms of tone-quality, but that quality is determined by the character of the instrument as affected by the intensity of the tone. The only value of the various refinements in piano touch lies in the fact that they refine the control of the force of the blow which determines the intensity of the tone. Mastery of arm, wrist, and finger movements all contribute to this purpose. No amount of fondling the key after it has struck the base, no variables in speed and accessory movements, no form of movement or muscular control before the exact moment at which the hammer is released, can modify the tone-quality.

The pitch factor in both melody and harmony is controlled by the composer and the instrument; and the tone-quality factor is controlled by the intensity of the tone for a given instrument. Our problem then was to design a camera which would record with high fidelity the force of the blow on the string, the various elements in the duration of the tone and the use of the pedals. This statement may seem very much oversimplified, but the fact has been established by adequate experimentation and is now recognized by competent musicians and instrument makers.

For years I had dreamed and speculated about various ways of doing this but was not satisfied with the progress until one morning when on my vacation I woke up and in perhaps less than five minutes visualized a way in which it could be done. I immediately communicated this to Dr. Joseph Tiffin, in the laboratory; and by the time I returned from my vacation, the Iowa piano camera had been built.

This camera is comparatively simple and highly reliable. It operates on an ordinary piano in a sound-conditioned room where the pianist can perform under very much the same conditions as in radio broadcasting. He sees or hears nothing of the recording process; but by the time he has completed the movement of a sonata, for example,

hundreds of feet of film contain an exact account of every item in the performance. The camera records the time for every element in the performance in hundredths of a second, the intensity in terms of the force delivered to the string by the hammer, (which can be reduced to decibels of loudness) and the use of pedals. Each note in the succession of chords has an individual record. The record as a whole is a mine of information which can be dug out in proportion to the time, patience, and insight of the experimenter.

Here is an example of a fundamental tool, really an automatic recording apparatus, which takes the analysis of piano performance from the field of hearing and makes the performance score objective in terms of black and white where we can measure, count, and classify in strictly scientific terms. By such means we can verify or disprove the theories of the past and discover new ones. Thus, this technique is entering upon a new stage. It gives us a new type of performance score which paves the way for an original scientific approach to the analysis of principles of piano performance.

On the basis of this type of exact information a new type of stencil can be cut on the roll for the mechanical piano player, reproducing with extraordinary fidelity the actual interpretation given by an individual artist. In comparison with this change, the ordinary player piano roll is very crude and imperfect. The task is an endless one; but like the discovery of a new continent, it leads to wealth untold.

Strange to say, so far as I know, this is the first and only piano camera that gives a comprehensive record of the entire performance. It opens up a new frontier in the science of musical art which will be a fascinating tramping ground for the musicologist. Let me repeat, it reveals the exact interpretation given by the pianist and by transferring this to the roll of the player piano, the mechanical player can do justice to the artist through the fidelity of the reproduction. Page the promoters of player pianos!

Numerous illustrations of procedures like these five could be drawn within the various branches of laboratory experiment in the Iowa laboratory; such as, devices for the measurement of nerve impulses in brain waves, instrumental procedures for the study of principles of composition in art, a recording of dermal responses to emotion stimuli, the use of a bi-dimensional camera in industry and art, and a long range of means for the recording and control of musical instruments.

Chapter IV

A VISIT TO THE ACOUSTICAL LABORATORY

Let me invite the reader to come with me for a visit to a branch of the psychological laboratory. Like the visit to a world's fair museum, such an inspection can be only superficial and fragmentary, calling attention here and there to outstanding problems which have been worked upon in the laboratory and to typical apparatus employed in the laying of foundations for this inceptive science of the psychology of music and speech. In so far as possible, I will introduce each subject by stating the general purpose and field in which it is used.

While all the instruments and techniques to be mentioned in this section were designed primarily for the purpose of the psychology of music, they are of such a fundamental nature for the study of sound that they are practically all used now in a number of specialized divisions of the laboratory, especially those which are concerned with hearing, tone production, and phonetic theory. The designing of instruments has been a matter of co-operation on the part of staff members, students, and specialists in underlying fields — notably, physics, physiology, and electrical engineering. Instead of reporting contributions to the psychology of music made possible by these inventions, I shall speak mainly with reference to the instruments that we see as we pass through the laboratory.

PHONOPHOTOGRAPHY

The recording unit of the laboratory which we now enter has been in a long process of development, taking advantage from time to time of new inventions coming upon the market, the recognition of new specific needs, and the improvement of sound-conditioned rooms. Microphones, for example, have improved every year for the last thirty years, and it is desirable to have the latest and best of these. New vistas for acoustic measurements are continually being discovered and adapted for specific purposes.

Let me describe a typical procedure in recording the performance of a singer or player, speaking in terms of the singing situation.[15] The

15 See Tiffin, Joseph: Univ. of Iowa Stud. in Psychol. of Music, Vol. I, 1932, Pp. 118-133.

singer comes into this acoustically treated and musically acceptable studio laboratory. The set-up looks very much like a radio studio. The singer is alone in the room, standing before a microphone, without any surrounding disturbances, and aware of the fact that his voice is going to reach a large and critical audience. The song may be one of his first choices for artistic rendition. He sings in his best artistic mood, as it were, to the large audience over the radio. Thus he should feel that he has a large and inspiring audience not only at the time of recording but through a phonograph record and all the objective facts revealed by the camera.

In the adjoining room, there is equipment for the recording by phonograph and camera, several of which may record simultaneously. Thus a permanent phonograph record is made and a battery of cameras simultaneously records pitch, loudness, time, and timbre for every note on moving picture films in terms of frequency, intensity, duration and wave form. These films contain the complete and highly detailed permanent record of every significant element in the musical sounds; namely, the tonal, the dynamic, the temporal, and the qualitative which become the research material for measurement, reconstruction, and interpretation.

The studio is of a character that musicians and listeners are accustomed to. The record contains not only the singer's voice — pure and simple, but is modified by various acoustic characteristics of the room and possibly from outside sources. To eliminate such room and environmental characteristics from the recorded voice, the singer may repeat as nearly as possible the same rendition in an adjoining dead room. A dead room, for this purpose, is one which has been built and treated acoustically so as to eliminate practically all reverberation from the walls, ceiling and floor of the room and any of its necessary contents. It is also proofed against sounds from outside. By repeating the original rendition in this room we have the record of the sound of the voice in a so-called musical environment for comparison with the sound of the voice by itself in the dead room.

In such recording we have a choice of various types of cameras, the most convenient of which is the strobophonophotographic camera which automatically furnishes a chart or picture of all the tonal, temporal, and dynamic modulations in the sound on single film. This is an extraordinary time-saver as it takes only a fraction of the time actually required for the reading of the more detailed films of the measurement of pitch, loudness, and time. The camera which records

the form of the sound wave, selects "fair samples" of tonal timbre and records on a separate film at very high speed, which is essential for the harmonic analysis that is to follow. Thus in the time that it takes to sing a song, the more or less automatic outfit furnishes a complete record of the performance which is of permanent character and can be analyzed in great detail. From it we can reconstruct a performance score and make quantitative tabulations for any feature measured.

Bearing in mind that the interception of sound waves, which constitute music, and their faithful reproduction both to the eye and to the ear by phonograph or camera, are almost universal requirements for the study of any singer, musical instrument or other tonal performance for measurement, we realize at once that this recording studio is by all odds the busiest part of the laboratory and is utilized for scores of different purposes, often unrelated but all calling for a faithful record of sound.

In all these recording devices, the human element from the experimenter must be eliminated so that all the recording is done automatically with far higher precision than could be produced through the control by eye, ear, or hand. The sound wave must speak for itself so that it can be faithfully interpreted whether it represents varieties of sound in nature or in art, regardless of how generated — through voice or instrument.

The same microphone that feeds into the camera is connected with a phonographic recording machine so that a high-quality permanent record of what was actually rendered is preserved for the ear. Thus the investigator has at hand the means of comparing what is heard with what is seen in the moving picture, item for item.

A PERFORMANCE SCORE

The photographic record on special moving picture films, as described for a five-minute song, may contain thousands of specific facts bearing on the tonal, dynamic, temporal, and qualitative aspects of every note of the song, each measurable and exactly definable. We were at first baffled by the accumulation of such masses of data without any simple way of sorting and representing them. A solution was found in the design of what we now call the "performance score." In its simplest form it is somewhat like the ordinary musical score. (See examples in *Psychology of Music*, 39 ff., 98 ff., 114 ff., 189 ff., 204 ff., 250 ff.)

In such a score we can see as much detail as may be significant. It

is customary to record pitch, loudness, and time in this manner; and then, because of the great complexity of the timbre, to represent fair samplings of tone spectra separately. Having once adopted this idea of representing four elements of the song graphically, that scheme may be applied to any particular feature of music or speech sound studied in detail; for example, phrasing scores, rhythmic patterns, the vibrato, or the harmonic structure of the tone. All elements of the sound are represented graphically to the eye.

This recognition is analogous to the fact that a picture of an object can be represented adequately in three dimensions of space and color. The painter has the means of representing in a single picture all desired degrees of variation in these three dimensions of space and a vast variety of variants in color. Imagine for a moment how helpless we would be if it had not occurred to some one that all types of objects and situations could be represented in pictures. That would be analogous to the situation in which we found ourselves in music. The performance score is a unified picture in three or four dimensions of music as it is actually performed. Of course the reason we have not had such pictures until recently lies in the fact that the means of making them were discovered only recently through the invention of sound photography.

Just as the recognition that every feature of a musical rendition can be represented in terms of four elements brought order out of chaos in the laboratory measurement, so now the adoption of various types of performance scores representing each of these four elements complements this by enabling us to assemble and interpret great masses of facts in terms of a fairly simple picture. Without such language and pictorial interpretation, most of the findings of the camera would have been lost. One can get some conception of the mass of material contained in a performance score if he realizes that for each note in the original musical score, there is a graph showing exactly the form of attack and release and all the minute changes in pitch and loudness during the body of a tone with the time and rhythmic value of each element of change during the tone. Every element in the actual phrasing is shown; yet the score is so compact that it may not occupy more than twice the space occupied by the original musical score.

To the musician, it seems almost incomprehensible that much of which we are aware, for example, media for the expression of musical feeling, can be represented in simple, accurate, and definable language

and pictures. Before we realized the full significance of this, we in the laboratory were quite as helpless as is the musician in attempting to represent what seems to be a chaotic mass of detail.

It may seem like straining a point to say that the device for throwing all the hundreds of findings in a musical selection into a comparatively simple picture which we call the performance score is analogous to the adoption of terminology in the biological and physical sciences or in mathematics. But it may seem stranger still to assert that the performance score representing the world of music is to what we can hear as the painting or photographing of objects in color and relief is to what we can see in nature or art.

HARMONIC ANALYSIS

Let us go to another room which has facilities for the complete analysis of tone quality. We find that tone quality consists of two factors; namely, timbre and sonance. Timbre denotes the character of a tone in cross-section as represented by a single vibration. Sonance represents the changes in timbre, pitch and loudness which take place during the duration of a tone as a whole. The technique used here is known as harmonic analysis.

The theory of this has been known for a long time, but it is only recently that accurate and convenient instruments for the analysis have become available in various forms. Thus, with the Henrici analyzer [16] we can take an adequately photographed sound wave and run it through the analyzer, which will deliver on a series of dials a statement of the number and distribution of overtones or partials present, giving the percentage of energy in each. This can be converted into a graphic tonal spectrum in which we can see at a glance a true profile representing the timbre of the tone at one exact moment in the tone, namely, for the duration of a single vibration. These spectra may be either such as to show the actual percentage of physical energy in each of the partials or it may be converted into a spectrum showing the actual role that each partial plays in musical hearing.

By fair sampling of individual vibrations within a tone or in a succession of tones, one can obtain a true picture of the constant fluctuation in the internal structure of a tone; that is, sonance, which together with timbre in cross-section, gives a complete picture of the quality of the tone. The harmonic analyzer can determine the presence and

16 See frontispiece author's Psychology of Music, New York: McGraw-Hill, 1938.

the degree of prominence of as many as forty partials; that is, single pure tones which may be present in a rich tone of voice or instrument.*

By this means we can record and describe any voice or solo instrument — indeed any sound in nature or art — which is not made too complicated by the presence of harmony or gross noise. For the first time such complete analysis of the quality of the tone gives a true quantitative and detailed kaleidoscopic picture of the hundreds of changes which take place within the tone during the singing or playing of a single note.[17] In terms of such revelations, the science of tone quality is becoming as tangible, exact, and objectively descriptive as pitch, loudness, and time have come to be. This new conquest of science will revolutionize music in many respects. It will enable us to write specifications for the reproduction of any desired tone quality; it will lay foundations for the classification and definition of tone quality; it will enable us to identify types of goodness or badness in musical tones.

Out of the laboratory will come a standardized series of names for the basic variants in tone quality somewhat analogous to our speaking of the "ah" quality or the "ee" quality of a tone in terms of specific formants.[18] This will lead to the scrapping of the loose verbiage now used for the description of qualities of tone, and there will be a gradual development of a technical, definable, logical, and verifiable terminology in music. This development will, of course, be a slow process, but the goal is now in sight and clearly indicated.

Out of this new type of knowledge will come new techniques of teaching of the quality of voice or instrument which will greatly shorten the time of instruction, make the training intelligent, and lead to an hitherto unknown degree of precision in the discriminating control of the timbre and sonance of the tone. In practical music, the concept of tone quality is still in the dark ages as zoology was before we had the concept of genera, species, varieties, and types.

SYNTHETIC TONES

We may now logically turn from the analysis of tone quality to its reproduction and synthetic reconstruction with tone generators. Given, for example, the harmonic analysis of a violin tone or a sing-

* Within the last few years new types of harmonic analyzers have become available for specific uses which simplify the procedure, save time and expense, and make them more readily available for limited purposes.

17 *Ibid.*, p. 107.

18 *Ibid.*, p. 116 ff.

ing voice, the question arises: Can such a tone be reproduced according to specifications? To this question we found a happy affirmative answer in terms of the tone generator and its use as described in Chapter III.

THE PIANO PERFORMANCE SCORE

It will be observed that this piano camera works on entirely different principles from those described for the recording of solo instruments or voices. For piano performance scores, see the chapter on Piano in the *Psychology of Music*, which gives illustrations of the structure of the camera, the character of the photographic record and piano performance score.

MUSICAL ROBOTS

No musician can play the same note alike twice in succession. For this reason, when we undertake to study such instruments as the violin, the clarinet, and the oboe, it is necessary to set up exact conditions for playing which can be maintained in steady tone as long as desired. Take, for example, the violin. If we wish to determine how much of the violin tone is due to the resonance of the room, it is necessary to play a given sustained note, first in the musically acceptable studio, and second, in the dead room, where there are practically no reverberations. This, of course, could not be done by bowing.

Dr. Arnold Small, starting from the technique developed by Abbot at Purdue University, built an adjustable holder for the violin capable of maintaining the instrument in any desired position or any desired degree of rigidity with the possibility of varying one factor at a time. The bowing is done with a continuous belt which is shaped like a hair bow and yields a comparable quality of tone. This bow can be set up to control its relations to the string, the degree of pressure, and the speed of movement from the face or width of the bow band. The essential thing in this set-up is that the experimenter shall be able to maintain and repeat a tone of a fixed timbre and sonance as long as desired.

Beyond this stage the procedure is the same as in ordinary recording for voice or instrument; that is, oscillograms are taken at high speed to record the form of the sound wave with fidelity. The sound wave is then run through an harmonic analyzer which delivers the data from which we can construct the tone spectrum under a given condition. To use a figure of speech, this harnessing of the violin is a way of putting this extraordinarily delicate and responsive instrument

under exact control for a single note at a time. Given such control it can be made the job of a lifetime, or generations, to work out in minute detail not only the general characteristics of a given instrument but step after step to vary one factor at a time.

Here is one example of a robot in the laboratory. Horne and Small[19] wanted to determine the role of the mute in violin playing. Starting with a mechanically-played violin they took the standard mutes on the market and added to these a number of specially made mutes so as to get fair samplings of the effect of the weight, the size, the shape, the material of which they were constructed, and different ways of mounting. Each of these was varied in turn, and therefore the form of the sound wave that was recorded under each of these conditions revealed the effect of different mutes upon the tone. For complete analysis of the effect of the mute, many other factors would, of course, have to be taken into account. The cumulative findings would give us a progressively refined measure of what a given mute under a given condition actually contributes to the timbre of the tone, all other factors being kept constant.

Similar procedures have been followed in the study of the bridge; and as these are progressively refined, another series must be made to determine the effect of a given bridge on a given mute, and *vice versa*. In this manner, hundreds of specific factors in the violin can be isolated and measured.

The same principle is applied to other instruments; for example, here is an oboe robot in which the human element is eliminated. It is energized mechanically from a constant pressure source, and every factor that enters into the character of the tone is under control. The same principle is applied to other families of instruments. It can readily be seen that the introduction of the robot into the experimental laboratory is one of the first essential conditions for the rigidly exact study of the character of instruments and the techniques of playing them. So in musicology as in war, the latest advance lies in the projection of a mechanized unit.

One can readily realize what a vast field of exploration is laid open by these techniques which are just beginning to come in; first, as a result of the high fidelity of the latest microphones; second, by the facilitation of harmonic analysis with new types of instruments; and third, by the possibility of putting the playing of an instrument under

19 Seashore, Horne and Small: The function of the mute on the violin. Science, 1939, 89, 403-404.

constant control. Developments of this kind attain their most vital significance when they operate for research in the school of music, as at Iowa, where research students in music have full access to the laboratory.

MEASUREMENT OF THE EXPRESSION OF EMOTION IN MUSIC

The most outstanding example we have of the measurement of the expression of emotion in music comes in terms of the vibrato in voice and instrument. For the study of this, a great variety of instruments in the laboratory have been utilized.

The laboratory scientist is an explorer, always looking for new frontiers. Among his thrills are the discovery of something important entirely unknown before, the bringing of order out of chaos in a virgin field, and the actual achievement of something that it has been generally agreed could not be done. Such an achievement is the measurement of the expression of emotion through music. The problem has been nibbled at for half a century by measuring its effects on pulse rate, breathing, blood pressure, metabolism, distraction, and the psychogalvanic reflex. But these are all fragmentary and more or less accessory factors. However, all have one element in common; namely, the attempt to measure the intensity of mental activity in terms of some physical expression. They have revealed a great deal about the physiology of the expression of emotion, but none of them has attempted to measure the expression itself; that is, the actual musical form that the expression takes.

We were fortunate in being able to isolate one element in the expression of musical emotion, show exactly what form this expression takes in actual music, and conduct experiments for a number of years leading to exact analysis and description of this form of expression. For our purpose, we took what seemed at the time a comparatively insignificant factor; namely, one of the thirty or more musical ornaments, the vibrato. Relying upon the varied resources of the laboratory, we were able to make an exhaustive analysis of what types of the vibrato exist, the frequency of their use, the role they play in musical emotion as a whole, norms for tolerance, and methods of development. The results of these experiments are reported in detail in two monographs: Vol. I and Vol. III of the *University of Iowa Studies in the Psychology of Music*, and numerous scattered articles in the standard journals.

Instead of looking for the apparatus, let us simply recall what has

been accomplished by rigorous experimental procedures. Some time ago I analyzed all our findings which were based rigidly and logically upon exact measurement and found that we had answered in a significant way more than two hundred questions by the measurement of the vibrato. In order to give a fair sample, here is a list of twenty-five of these:

What is the vibrato?
How can the vibrato be recorded and measured?
What are the musical elements of the vibrato?
What is a good vibrato?
What is a bad vibrato?
What is the relation of vibrato to tremolo?
How general is the use of the vibrato in good music?
What is the origin of the vibrato?
How does the vibrato develop with age and training?
Is the vibrato desirable?
What is the difference in the vibrato of voice and violin?
How does the vibrato function in other instruments?
How does the vibrato vary with musical mode and emotion?
How does the vibrato vary with register, loudness, tempo, and timbre?
What are the norms for pitch vibrato?
What are the norms for intensity vibrato?
What are the norms for rate of the vibrato?
How does the timbre pulsate in the vibrato?
What is the difference between the actual vibrato and the way it is heard?
What are the normal illusions which make the vibrato tolerable?
What is the difference between scientific and musical hearing of the vibrato?
What is the physiological theory of the vibrato?
What can training in the vibrato accomplish?
Should formal training in the vibrato be encouraged?
Is there musical significance in this knowledge of the vibrato?

It took a long time to answer our first question: *What is the vibrato?* Through the analysis of adequate samples of performance scores for voice and instrument we found that there are three distinct vibratos; namely, pitch vibrato, intensity vibrato, and timbre vibrato. The first two can occur independently or in combination, while the timbre vibrato is a result of these. To set up a desirable definition, it was necessary to state what a particular vibrato contributes to the music. After much analysis we arrived at the decision that a good vibrato contributes toward the flexibility, the tenderness, and the richness of the tone, each of which has a specific and well-recognized emotional value. Thus we arrived at the definition: A good vibrato is a pulsation of pitch, usually accompanied with synchronous pulsa-

tions of loudness and timbre, of such extent and rate as to give a pleasing flexibility, tenderness and richness to the tone.

In this definition the first part identifies the three kinds of vibrato and the second part indicates the musical result of these pulsations. Two claims may be made for it: first, that it is exhaustive because it recognizes all the four possible elements of tone in which pulsations can occur; and second, that it is verifiable because it is expressed in terms of objective measurement.

It will take some time before the definition and our answers to the numerous questions involved will penetrate musical literature, but it is gratifying to know that it is coming very fast. It has already made its way into the textbooks, dictionaries, and the encyclopedias, and into common-sense conversation on the subject. The most progressive music teachers and the virtuosi now on the stage are getting the news about the vibrato and are becoming greatly concerned about their exhibition of it. We have numerous cases in which the vibrato of a singer has been greatly improved by the scientific findings and other cases in which voice teachers have taken a radically new attitude in the development of its refinement.

But the vibrato does not differentiate emotions; for example, it does not differentiate fear from love. It merely expresses three elements of beauty in tone; namely, flexibility, tenderness and richness of tone which have affective value. This negative finding was most surprising and is far-reaching in its consequence for musical performance.

Turning from the vibrato to determine what elements in the musical rendition characterize a particular emotion, we now have in progress an experiment of a type introduced by Fairbanks [20] in speech by which it is possible to show whether or not such emotions as contempt, anger, fear, grief, and indifference can be recognized in music by pitch alone. We can then fractionate the pitch problem to determine what characteristics of pitch are significant, and how much of it is due to the type of glides and portamento, to the pitch register, to rise or fall in cadence, to the steadiness of the pitch, other factors being kept constant.

Then we may proceed in a similar manner, isolating in turn the factors of loudness, time and timbre, each of which may be fractionated to determine what effective media differentiate emotional expressions.

20 Fairbanks, Grant and Pronovost, Wilbert: An experimental study of pitch characteristics of voice during the expression of emotion. Speech Monographs, 1939, 6, No. 1, 87-104.

The experiment may be carried further, especially into the fields of rhythm and consonance. Recognition of data of that kind will furnish composers evidence of what actual media are at their command. Although there are current empirical theories which guide composers, they are of the hit-and-miss order and need to be confirmed and implemented.

THE VOCAL CORDS

The theory of the function of the vocal cords has been represented in armchair controversy for ages; but it has only been in the most recent years that we have been able to attack the problem in adequate experiment through the extraordinary developments of moving picture photography. Much of the pioneer work in this field was done in the Iowa laboratory.

We speak of three parts of the vocal apparatus: the vibrators, the generators, and the resonators. Air pressure acts as a generator upon the vocal cords setting them into vibration, and the tone thus generated is modified into significant and meaningful character through the action of the resonators in the oral cavities, including movements of lips and tongue. Using an ordinary dentist's mirror, one can see the vocal cords in action. Motion pictures of their movement can be obtained by interrupting the pictures at fast rates on the principle of stroboscopic vision.

The first work on this project in the Iowa laboratory was done by Koehler's first assistant, Dr. Metzger, who came here from Berlin for post-doctorate study and made a substantial contribution.[21] The work was next taken up by Tiffin and his associates who made further improvements and organized experiments, their primary objective being the determination of the extent to which the vocal cords vibrate in a single segment or in harmonic series of segments. In this they made fundamental contributions to theory.

There are now many forms of vocal-cord cameras, and we have standard films depicting the character of the movement of the cords. In the last year or two, two extraordinary achievements have been made in the Bell Telephone Laboratories; first, the utilizing of a lamp which secures brilliant illumination for the recording of detail; and second, the speeding up of the rate of moving pictures taken under this illumination to as high as 4,000 exposures per second. This

21 Metzger, Wolfgang: Mode of vibration of vocal cords. Univ. of Iowa Stud. in Psychol., Vol. 2, 1899.

achievement is an application of the principle developed in ballistic photography a few years ago.

When progress takes place at such pace, one can hardly begin to recite discoveries but feels gratified to realize that we now have complete mastery for verifying or disproving old theories and for discovering countless new elements in phonation through these new photographic techniques. It can be safely said that the old standing controversy on the theories of the function of the vocal cords which have for a long time been the center of heated discussion in the armchair is now settled; and through the photographic access to the cords, a new branch of science in acoustics and phonetics is developing.

What now interests us most in the psychology of music through measurements of this kind is a variety of practical applications; as to voice placement, it is the mechanism of registers and the relation between vibration of the vocal cords and the countless factors which enter into the energizing and the resonating of vocal sounds.

EYE-MOVEMENTS IN THE READING OF A MUSICAL SCORE

Here is a bi-dimensional eye camera. A good deal of experimental work has been done on principles of sight-reading.[22] Here, as in other fields, when one wants to do fundamental work, it is necessary to record and measure one factor at a time. One of the most fundamental questions with which we are concerned is the speed and direction of eye-movements in reading a section of a new musical score at sight, because eye-movement determines the course, the speed, and the integrating movements of attention from a psychological point of view. It is well known that in all forms of reading the eye behaves like a motion picture camera in that it moves quickly from one point of observation to another. Nothing is seen during the movement; but what shall be seen is the cumulative and fusing pictures taken at the moment of rest for each point of observation. The analogy of the eye to the moving picture camera is clear. Much of this can be studied by the various eye-movement cameras now available, recording the rate and character of movement in the horizontal direction.

But since in reading an ordinary score the eye makes up-and-down movements, indeed movements in all directions within a two-dimensional plane, a two-dimensional camera is required to facilitate the analysis. This camera is so built that it actually charts every move-

22 Brandt, Herman F.: Ocular patterns as an index of the attention value of size. Amer. J. Psychol., Vol. 53, 1940, 564-574.

ment of the eye in two dimensions so that one can see at a glance when and what features in the score were observed. This camera was built in the Iowa laboratory by a graduate student in educational psychology, Dr. Herman F. Brandt, originally for the purpose of analysis of eye-movements in reading, in the study of attention-value of advertisements, the analysis of the movement of attention in looking at a beautiful picture, and for motion studies in engineering. Indeed, it is a universal instrument for the measurement of bi-dimensional eye-movements.* In the field of music this opens up avenues of investigation within the area of sight-reading which will undoubtedly lead to a better understanding of the leaps and bounds, the selection of points of observation, preliminary skirmish, and consolidation of observations in sight-reading. These may all be measured objectively in terms of this camera which records on a moving picture film. For psychological and musical purposes, they may all be interpreted in terms of the movement of attention.

This type of experiment, like all those we have considered so far, is perhaps of greatest significance from the point of view of theoretical psychology in that it gives a true insight into what actually happens in the specific types and tasks of human ocular behavior in perception. As I have said before, the fact that we have a specific practical purpose in mind does not interfere with our search for fundamental psychological facts in so-called "pure psychology." Indeed, the exactly controlled formulation of an experimental situation for a practical purpose may greatly facilitate the procedure in the search for fundamental truths in that the practical objective forces us to take into account factors which might otherwise have been overlooked.

One realizes the significance of this when he observes an expert pianist playing a complicated musical score at first sight. One may ask: How many elements in the musical score does he actually see individually, and how many are inferred from knowledge of musical structure? How does the eye move in a preliminary glance at the general character of the page as a whole? What role do exploratory anticipations play from stage to stage? How many elements in a chord or how many chords in a group can he grasp in a single point of observation? What is the relation between individual note, eye-movement, or phrase? In what order does he verify such preliminary impressions? What would happen if the composition violated musical

* This camera is now used as the principal measuring instrument in time and motion studies in the engineering college.

sanctions by injection of irrelevant notes? How many eye-movements does he make in reading a hundred successive chords at first sight? Are the rate and the direction of eye-movements indices to efficiency in sight-reading? What laws of movement for the reading of prose transfer to the reading of a complicated score? What fundamental changes in eye-movement take place in learning by the method of the whole as compared with the method of the parts? How in the world is it possible for the talented pianist to take a fully orchestrated score and render it in a normal tempo as a piano score at first sight? These and hundreds of other questions can now be answered by objective measurement under normal conditions of piano playing with a printed score in a conventional position for reading.

BRAIN WAVES

The psychology of music represents rich harvests in the form of crumbs which have fallen from the table of speaking films, phonographs, and radio. One is baffled by a realization of the fact that all space in and around us reverberates with magnetic waves which can be converted into sound — into music in all its intricate forms of complexity. One therefore wonders what there is in the human mechanism which is responsive to all these cosmic forms of vibration so that they can be registered meaningfully through hearing.

On this tour through the laboratory, let us take a peep into the brain wave laboratory. Our reason for doing so is the fact that primarily through the leadership of Dr. Lee Travis and a succession of his associates, Iowa was one of the pioneers in this field of investigation. The laboratory is one of the best equipped in the country for this purpose.

The subject to be experimented upon in the laboratory is put into a room where he rests comfortably on a couch. Two or more electrodes are attached to different parts of the surface of his head, and elaborate electrical registering apparatus records on moving picture film the presence of nerve impulses by means of the accompanying electrical deflection. It seems fantastic to see these pictures of the nerve impulse revealing its rate and variation with location, complexity, intensity and duration of the processes. We can not only see action-current-waves but can convert them into sound which we can hear. This harnessing of brain waves is in electrophysiology for nerve impulse quite analogous to the harnessing of radio waves for the conduction and generation of musical sounds.

The fundamental thing revealed is that the brain, like our electric lighting circuit, acts through alternating currents. Thus from the very beginning the principle of alternating current was adopted for our nervous systems because it is economical. That is an astounding fact.

There are certain basic rays — such as the alpha ray which beats at about ten per second — and a series of other rays of higher frequency designated by Greek letters. The same principles that register the brain wave can also be used in tracing the course of the nerve impulse from the sense organ through various intricate centers to the brain or from the brain through various centers to the muscle. We now have, therefore, the means of discovering the origin and course of the nerve impulse, whether it be incoming or outgoing. We may look upon the brain as a central station at which incoming and outgoing impulses are distributed through various centers in the spinal cord and other parts of the nervous system.

To give one illustration of the application of this to music, one of the problems in the study of the vibrato is to determine what elements of the nervous system control the pulsations of the vocal cords in the vibrato cycle affecting pitch, loudness and time. Pursuit of this problem is a fascinating one because it leads to the discovery of fundamental biological principles almost infinitely complex and yet frequently measurable and explainable. Here the musicologist is in a situation analogous to that of the astronomer, who with telescope and spectroscope, intricate mathematical theories and untiring observation, reveals law and order in the system as a whole, although he can observe only one infinitesimally small part of it at a time.

HEARING-LOSS

Let us enter this comparatively sound-proof room where we find audiometers of various kinds with which we can measure hearing ability, usually called acuity of hearing or sensitiveness to sound as distinguished from discrimination for sound. (See Ch. III, p. 39) On the table is a record blank on which the curve of normal hearing is represented by a straight line. Hearing-loss in the person examined is represented by a parallel line or curve which shows the degree of hearing-loss found at each pitch level in terms of decibels. Defective hearing is not generally a flat loss of hearing but shows up in various degrees at various points in the tonal register depending ordinarily on the character of the defect in the ear.

It is important to know whether a musician or a prospective stu-

dent of music is hard of hearing and if so, to what extent and of what nature. But acuity of hearing may not be regarded as a talent in line with the sense of loudness, pitch, etc., because with inceptive or moderate hearing-loss, the musician may have as keen musical discrimination for the sounds he can hear as is found in a person with good hearing. It is, of course, a notable fact that distinguished musicians have held combat with various degrees of deafness with extraordinary success and within limits up to the degree of complete deafness. The audiometer will, however, always be a key instrument in a studio for musicology.

Let me give just one striking example of a hearing-loss which affects every normal human being, musical or unmusical, with oncoming age. This is known as *presbyacousis*. It is seen in the audiograph taken at different ages. To use my own case as a typical illustration, at the age of forty my capacity for hearing the higher overtones was rather superior — at any rate, normal. I could hear a note of about 20,000 cycles per second. I give the rough figures because at that time we had no exact means of measurement. Now, when I am in the middle seventies and in a good state of health, interested in music, my upper limit of hearing has dropped to about 4,000 cycles per second. This is in accordance with the general biological law which affects the virtuoso and the great musical conductors just as it affects the ordinary man on the street.

What does this mean? It means that the rich musical tones which we hear now sound entirely different to us from what they did when we were in our prime. The change, however, comes on so gradually in the life of each individual that he does not suffer any shock and, as a rule, proceeds on the assumption that there is no deterioration of tone with progressive age.* It would probably be difficult to convince the aged conductor that he does not now hear in a tone what he used to hear at his middle age. While hardness of hearing which comes with old age due to the various vicissitudes affecting the health of the ear is a common occurrence, it is not always the case. Many persons have suffered no noticeable loss of hearing for ordinary orientation by the age of seventy although the character of the hearing

* A striking incident occurred when I first began to study this problem. Madam Gadski was singing in the city and was very much interested in seeing what we were doing in the laboratory for music. I suggested that we measure her upper limit of hearing. It was even then markedly deteriorated. I then tested her daughter who was with her, whose upper limit was high, and the mother kept calling to her, "There is no tone. I can't hear it." It was an embarrassing situation to have to explain to this madonna of the stage that her hearing had been overtaken by the immutable law of aging.

is invariably marked by *presbyacousis*. The loss is not manifested so much in deafness to high fundamental tones as in the loss of masses of high overtones. This loss of overtones is, of course, most significant in that it radically changes the timbre or quality of the tone. The change is seldom recognized with increasing age even among famous conductors because it comes on so gradually, year by year.

Our visit must come to an end. We have lingered around technical exhibits and spoken of their uses in music and speech. All of these find application both in allied fields and in more remote fields; such as, physiology, physics, eugenics, education and anthropology. The laboratory is well equipped among many other fields of research; but, as in all research, we must fractionate the problem: the visitor must see a few things at a time.

Chapter V

PSYCHOLOGY IN MUSIC

THE GROWTH OF AN IDEA *

The "idea" in this case is the conviction that *musical talent is subject to scientific analysis and can be measured.* Some forty odd years ago a colleague in the university faculty who was a very fine violinist kept boasting what a fine musical ear he had. One day I rose to the occasion and said, "Van, I'll find out how good your ear is by measuring it." The challenge was accepted, I devised the apparatus, made the measurement and found that he could hear a difference of about one-seventieth of a tone. This was an objective fact, specific and verifiable.

At that time it was a new idea that one could measure specific personal traits quantitatively. Terms like differential psychology, individual differences, talent chart, I.Q., vocational guidance, educational measurements, statistical methods, applied psychology, the psychology of music and many other facts about the recognition of the individual and his personal equation which now loom up so large were at that time practically unknown.

It is my purpose here to illustrate in a somewhat intimate and personal way the normal growth of laboratory research from a germinating idea as it can be traced in the Iowa laboratory. My treatment must, of necessity, take the form of evaluation and bold touches in highlights rather than the amassing of descriptive facts and details.

Van's sense of pitch had been measured, but what did it mean? To answer that question in part, I measured myself, and, to the surprise of both of us, I found that my ear was as sensitive as his. But this did not leave us much wiser, although on more nearly equal terms. So I measured the sense of pitch in a class of thirty students and found that they varied from the ability to hear approximately one-hundredth of a tone to the inability to hear a difference of one-half tone. This then was the beginning of a new scale of interpretation. Van and I could compare ourselves with others. This measurement was re-

* Reprinted from The Scientific Monthly, 1941, 52, No. 5, p. 438-442.

peated upon hundreds of adults, and reliable norms of distribution of capacity were established.

The question then arose: What is the cause of these very large differences? When we found that of two normal persons, one may be more than one hundred times as keen as the other in pitch discrimination and that this is relatively fixed, our first resort was to refer it to differences of intelligence or powers of observation; but, to our astonishment, we found that there was no significant correlation between the sense of pitch and intelligence. Indeed, the student who made the poorest record in the sense of pitch in my original series was one of the brightest of the class and is now a member of the faculty of the University of Iowa.

The next hypothesis was that it might be due to training. To verify this, we first correlated the records on the sense of pitch with the records on the amount of training in music that each student had had and found that there was no significant relationship. That is, a keen sense of pitch is not due to training. To verify this startling find we took all the children in an eighth-grade room and gave them the most intensive training possible in this specific act daily for a month, and we found that the distribution and degree of ability in this task remained practically the same at the end of the training as it had been before training.

At that time it was believed, on the basis of certain experimental evidence, that pitch develops with the age of the child, but our eighth-grade children had done as well as the university students. This was contrary to musical and educational theory at that time. We therefore established age norms from ten years old and up and found that aside from development in the capacity to apply themselves to a task of this kind, there was no evidence of improvement in the sense of pitch with age. In spite of the fact that normal persons show astonishingly large individual differences in capacity for pitch discrimination, it is found that this capacity does not vary consistently with age, intelligence or training.

Applying this to the evaluation of our first measurement upon Van and myself, we may say that our sense of pitch falls within the highest two per cent in a normal community; that it is probably a fixed, inborn talent which is relatively independent of general intelligence and age; and that it improves with musical training only in the same sense that the acuity of vision improves with training in art production or appreciation. It must be clear to any one that all these psychological

facts are of extraordinary educational, social, musical and economic significance.

These first and radical findings launched us upon a program for an intensive study of the sense of pitch which is still in progress and has borne most gratifying fruit in our knowledge about this type of individual differences as involving principles of pure psychology, and applications of this knowledge in anthropology, genetic psychology, heredity, music and education. Through this, our concept of a musical talent has been enriched and vitalized and we have discovered its basic role in countless situations in daily life, art and industry, where its presence had not been recognized before.

It was natural, then, that we should ask: What other talents may be analogous to this? This led us into an investigation of a number of recognizable units in the complex forms of pitch hearing, as in the hearing of consonance, harmony, melody and various types of modulations of pitch; and this led to the beginning of what we may call "the psychology of pitch."

We then made an objective analysis of tone to determine the characteristics of the sound wave and found that there are four and only four; namely, frequency, amplitude, duration and wave form. For the hearing of each of these characteristics of tone we recognized the necessity of a specific capacity; namely, the sense of pitch, the sense of loudness, the sense of time and the sense of timbre. These cover the tonal, the dynamic, the temporal and the qualitative attributes of sound.

We then entered upon a program of measurement and analysis of each of these on the pattern of the studies on pitch and followed these four basic factors into their variants, combinations and interrelations in the actual musical situation. This gave us a sound basis for the analysis of musical hearing.

For each capacity for musical hearing, both simple and complex forms, we must look for a corresponding capacity for performance or tone production. This gave us a classification of the motor capacities necessary for the control of sound in a musical performance.

This parallel classification of sensory and motor processes based upon the four characteristics of the sound wave was found to carry through the higher mental processes of memory and imagination, the higher cognitive processes of conception, judgment and reasoning, and the various aspects of feeling and emotion and all types of musical action. That is, when we remember a musical selection, imagine it,

think and reason about it, and analyze our musical feelings and all types of musical action, it is always in terms of one or more of these four factors or their derivatives. They constitute the content to which the music gives form. All musical creation, as in composition, is but the artistic arrangement of these four elements in musical content. All appreciation of music is in these terms. All mastery of musical performance may be expressed in these terms.

Recognition of this type of classification constituted a preliminary survey of our field for investigation and made elements of musical experience and behavior tangible for measurement and analysis in the laboratory. Thus we found ourselves in a most fascinating new field with opportunities for blazing trails in hundreds of directions theretofore unexplored. This new field we now call "psychology of music." As the field broadened, we found ourselves constantly drawing upon and contributing to general principles of psychology and were thrown into cooperation with allied and underlying sciences on a large scale.

It was gratifying to find that this subject could be treated either as pure or applied psychology, that the applied aspects might be treated experimentally in the same manner as problems of pure psychology and that the interests of pure psychology could be served in as clear and unhampered manner when a practical application was in mind as when it was not. We found ourselves constantly drawing upon and contributing to general principles of psychology and had to branch out in cooperation with allied and underlying sciences. Fascinated by the magnitude and the immediate yield in this field of the science of sound, the staff and equipment of the laboratory was for many years concentrated upon this objective at a sacrifice of many other possible laboratory interests.

At that time there were no other laboratories equipped for this operation; at every turn we were blazing new trails. The matter of equipment was and is yet a constant problem calling for ingenuity, invention and facilities for the building of instruments. The opening up of a new field of investigation calls for new types of equipment, means of measuring every aspect of sound, means for producing all musically significant types of sound, means for the analysis of each and every feature of the sound and means for the complete phonophotographic record of any musical performance. This represents a bewildering nest of complicated instruments. Fortunately, the psychology of music was really made possible by the extraordinary progress of invention and provision of instruments which came in through the

commercially profitable and scientifically intriguing developments in radio engineering. Without these, the best contributions of any university laboratory would have been insignificant.

But instruments are mere tools. They must be designed for specific problems. We could not shoot at the blue sky of all the psychology of music, and therefore we had to pick specific aspects which from time to time became tangible and significant. Of these, there was an abundance, all bearing directly or indirectly on the problem of laying scientific foundations for some phase of the art of music. One of the constant problems is the experimental definition of terms. Timbre, for example, was but little more than a French name. A permanent and verifiable definition had to be determined by experiment, and the loose musical jargon hovering around that concept had to be scrapped in favor of the experimentally determined definition of the word. This was the first step in the assignment of an understandable and vital function to timbre in music. Prevailing theories had to be submitted to verification, as in the case of the laws of harmony, action of the vocal cords, musical phrasing and scales. Our extensive publications of researches on such specific issues of musical experience and behavior tell an interesting story.

But the effort to deal with any single problem of musical sounds at once took us into allied fields, such as the perennial problems of heredity and environment and the science of genetics, the physics of sound, the physiology of hearing, the endocrine basis for emotion and electrophysiology of nervous control. Since the object of the investigation was music, there had to be constant rapport with current leaders in musical theory, education and criticism. The barriers among such fields have broken down, and in the last fifty years progress has been made by leaps and bounds. As a result of the recent development in acoustics in the interests of radio and all other forms of sound engineering, we had in most cases only to share and help to harvest the common findings.

Out of the science built from all these sources, new applied sciences have gradually emerged. Mastery of the measurement of musical talents took us into the midst of a practical field of musical education. As the measurement of musical talents became recognized as a scientific approach to the problem of individual differences, differential psychology took many new turns. Refinement of mental measurement in hearing led to special fields of mental testing. When we went into the World War, we had to answer the question: What can psychology

contribute? and some notable contributions came from the psychology of music in the location of U-boats and the selection of personnel. Musical anthropology took a new scientific turn. All we had learned in the study of musical sounds had its parallel and counterpart in speech, and hence arose the psychology of speech. While each of the arts has its medium, they all have certain principles, talents and goals in common. In recognition of this, there grew up in the laboratory a separate division of the psychology of graphic and plastic arts. Musical anthropology which had previously been loose observation turned experimental. As we learned to record and interpret musical performance, problems arose in regard to what is possible and what is good in musical performance. And through the years of accumulation of musical terminology, classification and experimental theory, we found ourselves laying foundations for a scientific musical esthetics. None of these problems has been solved, but the mere naming gives us some conception of the richness of possibilities of a new field, such as that of the psychology of music.

While much of the overhead work in the Iowa laboratory has been my happy lot, the accomplishments in the whole program must be accredited to the large body of students and colleagues in the department who have shared in the building up of the laboratory. It must be clearly understood that the progress in large as we now see it is not the work of a single laboratory or the fruitage of a single idea but rather the integrated findings of many interlocking sciences, of many laboratories in each science and often of many individuals in the laboratory. May I add also that the type of specialization here involved has furnished the workers in the field an excellent opportunity for broadening the scientific horizon and extending the vision into approaches to the science of the art of music.

Such is a sort of privileged retrospect under the license for reminiscence extended to an old man who has lived through much of it. Perhaps the picture is overdrawn. However, every statement is subject to verification. I have tried to see the development in relief, especially as it germinated and rose into the structure of a scientific family tree in rich branching with foliage and fruiting. The germinating idea was that "it can be done"; musical talents can be measured. There was no sudden leap from the sprouting of this idea up to the present level of achievements; but progress was made by continuous logical and tireless work going by natural steps from one stage to another. The germinating idea was not exactly new; it was simply vitalized and

thrown into line with parallel developments. Perhaps the most all-impressive contribution that has come out of this entire development is the revelation of how little we know of such a "knowable" subject.

MEASURES OF MUSICAL TALENTS

As we have seen, basic music talents vary extraordinarily, both in kind and degree. Many of these capacities and abilities can be measured before musical education is begun. In the art of music the early discovery and analysis of these traits is of inestimable value for the purpose of guidance in music education.

About 1910 I conceived the idea of standardizing a battery of measures of musical talents on the theory that the hearing of music demands certain capacities which may be identified by the characteristics of musical sound which must be perceived. The recognition that there are only four such basic characteristics — pitch, loudness, time and timbre — was a strategic step in the development of the laboratory approaches to the analysis of music and has proved a great means to simplifying, economizing of procedure, and thoroughly analyzing all our musical problems. For the first three we soon developed adequate instruments, but the instrument for the measurement of timbre was not satisfactorily standardized until 1936. To the three basic capacities, pitch, loudness and time, we added three complex capacities; namely, rhythm, memory and consonance, making a battery of six for each of which we had developed a basic measurement.*

The first public demonstration of the use and interpretation of these measures was made before a women's club in Des Moines about 1912, and soon after that we examined all the fifth and eighth grade children in Charles City. These preliminary trials gave us much insight into the needs and possibilities of measurements of this kind, but the apparatus was expensive and bunglesome and we saw no hope for making it generally available for school surveys.**

* In addition to these we started out with auditory acuity but gave that up for two reasons: first, that it does not lend itself readily to group measurement; and second, that a mild loss of hearing does not necessarily interfere with the essentials in the hearing of music.

** The two pupils in Charles City who topped in these measures proved interesting. One was a girl from a well-to-do family who had made good progress in music and through this report was greatly encouraged to enter the musical profession and is now an effective member of the faculty in a music school. The other, who rated equally high, had had no musical training and came from a slum district. When the women's club at Charles City heard of her achievement in these tests, they arranged to give her a musical education but were stopped by the mother who said that she would not allow her daughter to be educated

Then it occurred to me that these were all measures of hearing and could be recorded on phonograph records, thus standardizing the measures and making them inexpensive and generally available. This was undertaken in 1919 by the Columbia Phonograph Laboratories in New York City. This type of recording was all pioneering, and we met with many difficulties; but on the whole the result was good, and the Columbia Phonograph Company handled the matter efficiently. Later, when this company was reorganized the measures were taken over by the C. H. Stoelting Company of Chicago.

In the manual accompanying the original edition of the phonograph records, I made this claim which I think has been fully justified:

> These measures of musical talent present the following characteristics: they are based on a scientific analysis of musical talent; they are standardized for content that does not need to be changed; they give quantitative results which may be verified to a high degree of certainty; they deal with elements which are functional in all music; they are economical in that expensive measuring instruments are replaced by phonograph records; they may be used with any language or culture level; they are simple and as nearly self-operative as possible; they are adapted for group measurements; they take into account practice, training, age, and intelligence.

It is rather remarkable that these measures stood up for twenty years without revision and with continually increasing use for many purposes. The purpose and character of the revision is fully stated in Saetveit, Lewis, and Seashore,[24] which also contains an extensive bibliography.*

away from home; the result was that this unusually gifted girl did not have further opportunity for a musical education.

One of my first professional services was in testing the three children of a minister at Newton, Iowa. The oldest girl had had constant training in music for about ten years but was not making satisfactory progress. Her sister, four years younger, had had but little instruction but made splendid progress in her music. I found that the oldest girl was seriously deficient in most of the capacities represented by my measures and that the younger two children rated very high. My recommendation was that the older girl be encouraged to find some other outlet for the family's artistic ambition and that the best of musical facilities be given the two younger children. It is significant to record that this professional recommendation failed in that the good minister was determined to equalize achievement in his family and therefore sent the older daughter to the New England Conservatory of Music which accepted her and carried her through several years. In 1939 I got a note from the minister reminding me of the event and reporting that his daughter had succeeded in graduating from the New England Conservatory and that she was now happily married. But he did not intimate that music was playing any role either in her personal life or in the community activities after her marriage.

24 Saetveit, Joseph G., Lewis, Don and Seashore, Carl E.: Revision of the Seashore measures of musical talents, Univ. of Iowa Stud., Aims and Progress of Research, No. 65, 1940, p. 7.

* In view of my retirement from active participation in the laboratory and for the purpose of contributing to their maintenance by my successor in the department, these measures

It is interesting to note that in contrast with achievement tests and other tests which can be put out and require new editions at frequent intervals, there is no such problem with these measures; it would seem reasonable to suppose that the revised edition could stand as did the original for twenty years without change.

As soon as the records became available, we undertook an extensive survey of the Des Moines public schools. This survey, which gives the first comprehensive and concrete picture of the distribution of these talents among school children, will go down in history as marking an epochal point of departure in the analysis of individual differences, especially as it put into black and white the extraordinarily wide range of differences in these capacities. Norms for the original edition were based on this survey by Gaw.[25]

My first important demonstration of these records was made at the meeting of the National Music Supervisors' Association at St. Louis in 1919. That association set aside a whole afternoon and submitted every member to the test.*

On the whole, the afternoon was a success. Up to that time the association had carried as a legend on its stationery, "Music for every child in the United States at public expense." But, as a result of the showing that afternoon, the executive committee changed it for some time to, "Music for every child in proportion to his capacity at public expense." Before that music teachers had been fighting for a recognition of music among the three R's in the public schools and were shockingly ignorant of individual differences and their significance in musical education, vigorously militant for what they called "democracy." That session in St. Louis was perhaps the first organized awakening of music teachers to a recognition of the significance of individual differences in musical talent. Since that day great progress has been made in this respect.

have been made the property of the psychological laboratory with the provision that all income from them shall be used for the encouragement of research in this general field.

25 Gaw, Esther Allen: A survey of musical talent in a music school. Univ. of Iowa Stud. in Psychol., Vol. 8, 1922, 128-156.

* Several amusing incidents occurred during that session. For example, the supervisor of music in one of the largest cities in the middle west made a very poor record on all the tests. He then rose and, fully conscious of the dignity of his job and adulating himself on having had his convictions verified, announced that he now had objective proof that these measures did not mean anything because he, a successful music supervisor, had made a very poor record. I then asked what instrument he played, and he said that he did not regard himself as a virtuoso on any instrument. I asked if he were a composer; no, he was not. I asked if he were a conductor; no, he was not. Then he volunteered, "I am a supervisor of music." "Ah," I replied, "that explains it. You are a business man, and business men do not necessarily rate high on musical talent." This did much to swing the audience to my side.

Soon after that meeting, the committee on courses of study published a program of minimum essentials. It struck me that those were still set up on the assumption that all children were exceptionally talented or could attain the same goal. I therefore sent one of my assistants, Miss Windhorst, to make talent measurements in two cities, Kansas City and Omaha, in which we probably had the best example of public school music at that time. The records showed clearly that the standards set up were not at all adapted to the heterogeneous group for which they were intended. Indeed, they were very unreasonable.

Successive committees gradually came to realize through the school of hard knocks what our single experiment had so strikingly demonstrated. Various reports on standards of achievement have progressively grown emphatic and effective in recognizing the significance of individual differences in musical talent.

In making the recent revision of these measures after twenty years, it was gratifying to find that without any precedent, we had hit upon some of the most basic factors in musical talent. Indeed, in making the revision we discarded only one — the sense of consonance, and that, not because it was not a basic measure, but because we had not succeeded in restricting the response to a cognitive judgment which is essential. We could not overcome the difficulty of keeping a feeling of likes and dislikes or the effect of musical progression out of the judgment. However, if in the future there should be a reason for extending the battery, I think a way can be found for satisfying that requirement because this measure undoubtedly has marked predictive value. In the revision we were fortunate in having reached the stage of possessing a satisfactory measure of the sense of timbre, which to a considerable extent, overlaps the sense of consonance and was therefore substituted for it.*

My name is probably better known around the world for the circulation of these measures of musical talents than for anything else, although I have always regarded the development of these as a side product of the larger issues of the psychology of music in which we have been engaged. It is interesting to note that their use has been independent of language or social status so that the test material could

* One measure which I shall regard as one of the most fundamental, the vividness of auditory imagery, is not included in the battery because we have not been able to devise objective measurement comparable with the rest. However, I recommend that with the six measures, the rating scale published in my *Psychology of Musical Talent* or in briefer form in my *Psychology of Music* be used for this purpose.

be applied to a professional musician and to a primitive savage. Only the formal instructions would need to be translated into any foreign language with which they might be used.

I think it is fair to say that psychologists have recognized these measures as a legitimate output from the psychological laboratory, and textbooks and reviews in general have frequently referred to them as the most scientific battery for the determination of individual differences in specific natural capacities. Two reasons why they have stood up so well and probably will continue to do so are: they employ approved laboratory methods of measurement, being psychophysical measurements which have been the foundation for experimental psychology for the last fifty years; and no time or expense has been spared in adapting them for group measurements.

These measures have met with enthusiasms and antagonisms, both justifiable from certain points of view. The greatest difficulty has been the gullible acceptance of them as positive predictions of success in music; whereas, from the beginning we have insisted that the measures have two characteristics: first, they are specific, that is, one isolated factor such as the sense of pitch is isolated and measured; and second, the conclusion which shall be drawn from the findings is limited to the factor measured. This is a relatively new idea in the whole mental testing program, in which there is usually an attempt to get a general measure or single "quotient" to express the predictive value.

In our procedure we have called this the "Specific Theory" which is opposed to what we have called the "Omnibus Theory" in which one makes an unanalyzed sampling from which he can get a single index to musicality. Psychologists and educators not trained in laboratory procedures have jumped to the conclusion that the theory underlying these measurements represents atomistic psychology and ignores various forms of functional psychology, such as the gestalt, and the clinical analysis of the total personality in the total situation. The fact is that one who works critically and extensively in laboratory and clinical analysis of individual differences soon becomes convinced that he is dealing with elements which get their meaning from their setting; that is, gestalt. This meaning cannot be interpreted without recognition of the relation to the total personality, normal and abnormal, from the point of view of psychobiology. But when one attempts to make scientific analysis, he must begin with factors which can be isolated for the purpose of analysis.

In a current bulletin on the Seashore measures of musical talents [26] I have stated our position as follows:

(1) Each measure is a specific item in itself and must be validated as such; for example, pitch is to be validated not against musicality or musical performance as a whole but only for the role that the sense of pitch plays in the musical situation.

(2) It is not assumed that a good sense of pitch in itself is predictive of musical success. All that we have a right to assume on the positive side is that a person who has a fine sense of pitch ought to be capable of a corresponding control of pitch in musical achievement, other conditions being favorable. Difficulty in pitch intonation may however be of purely motor origin.

(3) The measure is most significant in its negative aspect in that when properly established, a low rating should be taken as a preliminary information of corresponding difficulties which may be encountered in musical pursuits.

(4) The sense of pitch is a measure of the basic ability to hear pitch. It therefore applies not only to the hearing of pitch pure and simple but also, though in a diminishing degree, to the hearing of pitch in its complex forms and in its integration with other aspects of tone in music, both in hearing and performance. Pitch discrimination is, of course, a standard unit of measurement in numerous fields of scientific work, and when so used must be validated against the purpose to be served. In taking this measurement from the laboratory we have called it "measure" in order to indicate that it is something different from paper and pencil testing, and for the battery we speak of "measures" in the plural to indicate their individuality. Generically we may, of course, speak of these measures as tests.

(5) Justification for isolating pitch, for example, as a factor to be measured, lies in the fact that both from the point of view of physical measurement of the sound wave and the most elementary psychological and musical analysis, pitch is universally recognized as essential to adequate musical hearing. There is, therefore, no ground for attributing this selection to some person's speculative analysis of the musical mind as a whole, the charge that it represents a species of "faculty psychology," or that it is contrary to the scientific approach to an integrated personality.

(6) These statements apply in principle to each of the six measures

[26] Saetveit, Joseph, Lewis, Don and Seashore, Carl E.: Revision of the Seashore measures of musical talents. Univ. of Iowa Stud., Aims and Progress of Research, No. 65, 1940.

in the present battery. The choice of these particular measurements rests in part on relatively low intercorrelations, indicating that they measure different things. It follows that the ranks for the battery should not be averaged as an index to musicality as a whole but should yield a partial profile. Here we see an analogy to the medical procedure where measurements of blood pressure, temperature, heart action, metabolism, etc., are measures of specific conditions in a state of health; but to diagnose the case, the physician must take a great many other factors into account. Users of these measures are therefore constantly warned to employ them as specific serviceable aids in connection with case histories, auditions, and other specific measures and above all with a reasonable modicum of musical insight and common sense before assigning general predictive values to them.

In view of these demarcations, we must refuse to validate these measures against unanalyzed judgments about musical achievement and turn to the more technical analysis of the factors involved in the spirit of scientific method in the laboratory for the purpose of gaining insight into the nature of the processes involved, even at the sacrifice of broad generalizations and ultra-practical simplification. (See *Appendix to Psychology of Music* for "Specific" and "Omnibus" theories.)

Since these measures are basic psychophysical measurements, they have their usefulness in all fields of rigid and efficient use of hearing, and therefore deal with fundamental approaches to acoustic science. Anthropologists have generally adopted them for the measurement of racial differences, the results of which have been published in extensive volumes. (See bibliography in publication quoted). They proved useful in the World War in the selection of listeners for submarines. They have the same type of role in the determination of talent for speech as they have for music and have proved to be of predictive value in this field. They have proved useful in ear-training courses for isolating and clarifying the elements of hearing in music. They have been used in the selection of listeners in industry and sports.

In short, whatever value they may ultimately have in the analysis of musical talent, the phonograph records have proved a convenient tool for psychophysical measurements in the units with which they deal. It has been unfortunate that persons who should have been competent to evaluate musicality in the integrated personality of the musician, as well as the unscientific artist, should gullibly take these six measures as measures of musical talent as a whole. No psychophysic measurement measures or positively predicts total competence in any field for guid-

ance. It may, however, reveal significant impediments for success. If I should point to one general result of great significance, it would be that in the entire acoustic field, the measures have called attention to the possibility of a scientific approach to the problem of individual differences in hearing.

One of the most significant aspects of the use of these measures is found in the investigation of problems of musical heredity. Professor C. B. Davenport in the Carnegie Institute of Genetics, early took notice of the factors involved in determining musical heredity and called me into conference. He showed me a row of steel files filled with case histories giving the family pedigrees of musicians in terms of expressed opinion in reply to questionnaires. When he realized how unreliable and radically different the findings of his inquiries were in comparison with our measurements, he took the drastic step of scrapping the files as of little or no significance for the scientific study of heredity and in various situations encouraged the use of the measures as the first step in gathering data on musical inheritance. In this he set an effective pace for the use of these measures in anthropological studies, and especially in studies of musical inheritance.

The first outcome of this co-operation was a joint project with the Iowa laboratory for the study of every available member of the six foremost musical families in this country in a most painstaking and rigorous series of measurements made by Dr. Stanton.[27] These were published jointly by the Carnegie Institution of Washington and the University of Iowa laboratory. It required infinite patience to get the good will and co-operation of the musician and his wife, their parents, children, and other immediate blood relatives. The findings of this investigation are on record and may furnish very extensive material for genetic interpretation in the light of theories of heredity which have developed within the last twenty years. I have recently published my revised recommendations for the use of these measures * in the study of musical inheritance.[28]

27 Stanton, Hazel M.: The inheritance of specific musical capacities. Univ. of Iowa Stud. in Psychol., Vol. 8, 1922, 157-204.

* A significant illustration of the use of these measures came to our attention two years ago when a high school girl who participated in the Iowa music festival failed in spite of the fact that she was recognized as very well-trained and supposed to be gifted in music. The outcome of the contest discouraged her and her parents, but some one suggested that she come to the University and have herself analyzed. This she did, and came out with a very superior record throughout. On the basis of her rating on these measures and a thorough analytical audition, she took heart and went into the national contest where she won first in her division.

28 Musical inheritance. The Scientific Monthly, 1940, Vol. 50, 351-356.

Upon the appearance of the revision, various requests came up asking for the privilege of using these records in broadcasts. This is an exceedingly important issue which is illustrated, for example, by the fact that in certain large cities where they have an internal broadcasting system, the supervisors of music have obtained permission to broadcast one measure at a time from their central broadcasting stations to representative grades in the public schools so that thousands of children can be examined under competent control in a single period.*

In order to facilitate such work, I have prepared twenty-five broadcast scripts which can be used over any single radio station or a regional hookup, either with or without sponsors, for the measurement of musical talents at a distance. The Radio Corporation of America is interested in this, and I am in communication with President Angell in regard to future developments of this plan. It is difficult to realize what a large increase in the scope of usefulness might be obtained if a series of lectures of that kind could be made a part of the music course in any city school system. My own satisfaction in having prepared this lies in the fact that it has given me an opportunity to give the measures as I think they should be given and demonstrate the type of conservatism which is needed in the interpretation of findings.

Any attempt to popularize technical psychological measurements encounters hazards and dangers galore. Nevertheless there is a satisfaction in realizing that these measures, which started out as intricate psychophysical measurements in the laboratory with complicated instruments, should through phonograph and radio reach a larger constituency and encourage the inceptive movement toward a scientific approach to music and speech.

THE EASTMAN EXPERIMENT

After the Des Moines survey had been completed, we saw the desirability of an extensive experiment in the practical field for the use of measurements of musical talents. I thought of securing permission for us to go into a large school system, such as that of Boston, St. Louis, or San Francisco, to make a systematic test of the reliability, validity, and serviceability of these measures in the actual school situation. I therefore went to the foundation of which Abraham Flexner was the president, and asked him for a subsidy for the project. He was interested but said:

* This testing service is now being tried out in the Swedish National Broadcasting service.

> "I think I know a better way. There is a new music school established by Mr. George Eastman in Rochester. That school will be open to experimentation and will furnish an ideal place to perform your experiment."

Accordingly, he called the president of the University of Rochester by long distance, mentioning his recommendation, and arranged for an interview with him the following day. The president was immediately impressed with the possibilities proposed, and Mr. Eastman was called in for a conference.

As a result of that conference, I was asked to become professor of the psychology of music in the Eastman School, a very bold venture without precedent. I could not accept this offer but recommended my first assistant, Dr. Hazel Stanton, who had then just completed her survey of talent in the six foremost families of American musicians. It was agreed that she would have the privilege of giving psychological examinations to every entering freshman student, following up the predictions made on these examinations for a period of years. This was a grand opportunity for experimentation. It relieved us of the financial worries and made an ideal set-up between psychology and music. The first director of the school doubted the wisdom of the enterprise, but he was soon followed by Dr. Howard Hanson, who gave the project sympathetic and vigorous support.

After the showing demonstrated at the end of three years, these examinations were made a part of the entrance requirements. In terms of the operation of them, a number of scientific experiments having a bearing on the analysis, rating, and prediction of progress of students in music were reported by Dr. Stanton and bulletins reporting findings were published from time to time. Her final report [29] which was published after ten years of experiment, constitutes a remarkable contribution to experimental psychology in musical education. This report contains an account of standardized techniques for the conduct of the experiment, a prediction of success, an evaluation of the extent and significance of such prediction, stability ratings, and the role of these records in the hands of the admissions officer and the director of the faculty. As that report is readily available, this mere mention of it may answer our present purpose.

The Eastman experiment, in many aspects successful, led to the undertaking of a great variety of experiments by musicians and psychologists in laboratories, music schools, clinics, and public school

29 Stanton, Hazel M.: Measurement of musical talent, the Eastman experiment. Univ. of Iowa Stud. in Psychol. of Music, Vol. 2, 1935. Pp. 144.

systems. Our report of the revision of the measures * contains a bibliography of 208 items dealing with measurements of musical talent, most of which were inspired by or devoted to experiments with these particular measures.

Notable among such experiments is the activity of Dr. Ruth Larson, music psychologist in the public schools of Rochester. In one of my visits to Rochester, Mr. Eastman reviewed the success of the experiment in the music schools and stated that it had saved the Eastman School a great deal of money by eliminating the unfit and by the same token had saved many lives from probable misery in the wrong career. "But," he said, "this is all negative. Can't you do something positive?" "Yes," was my answer. The result was that he called the superintendent of schools in Rochester for a luncheon conference and at this time it was decided to put a music psychologist into the personnel division of the public school system with complete freedom and responsibility for discovering, analyzing, and guiding musical children in a school system. This project was particularly appropriate because at that time the Eastman School was furnishing the instruments to students who came from the public schools in Rochester.

THE ACQUISITION OF MUSICAL SKILLS

One of the goals of the psychology of music is to apply scientific principles to methods of training which shall guarantee insight into the nature of the learning process, a shortening of the time of training, and attainment of higher precision and mastery than is ordinarily obtained. In this, it follows the universal requirement of the scientific procedure of dealing with one specific factor at a time, employing objective standards and measurements of performance.

Training begins with the most elementary steps by setting up efficient habits which become thoroughly fixed so that they function automatically in the actual musical situation. A fundamental requirement is that the pupil shall know exactly what element in the music he is trying to master in a given assignment, shall have an objective check on his achievement in this in every trial, and shall practice until this particular control of tone is completely established as a habit.

Instruments for such a purpose are fast coming upon the market and are reasonably priced so that, for the price of a good piano, one can equip a studio adequately. A single equipment of this kind can

*Op. cit.

serve an entire large school; the cost is not prohibitive for a music school or a department of music in a public school.

At present, the problem is to convince music teachers of the possibilities and significance of this scientific approach to musical training. The instruments are here and more are coming. The first essential is knowledge of the fundamental techniques in the psychology of music. Courses in that subject are fast developing in progressive teacher-training institutions. The range of possibilities is unlimited when we once establish confidence in the idea that it can be done.

One of the most valuable principles involved in most of these instruments is that the sound wave is converted into a visual picture so that the moment one sings or plays a given note, he will see on a dial or some other indicator, the exact performance of the element under consideration. These visual pictures of sound waves are to the student of music what the microscope is to the student of microörganisms: every element in the tone produced is enlarged; even factors not recognized by the unaided ear become clear and conspicuous.

In our round through the laboratory, I could have demonstrated a variety of instruments for this purpose. Let me here attempt to give a general picture of the resources for an elementary musical laboratory designed for training in the acquisition of musical skills. A laboratory of this kind assumes three aspects: first, the measurement of natural talent at the beginning of practice; second, training in the acquisition and refinement of specific skills in musical performance; and third, measurement of achievement. The talent testing should include on the one hand measures of musical hearing and, on the other, measures of natural talent for motor skills.

Seeing Pitch Intonation

This was illustrated in the section on the tonoscope in Chapter III. The tonoscope was first used for the study of improvement with practice; for example, a number of singers who were known to flat were given organized training for the purpose of eradicating the flatting habit wherever it was not due to a faulty ear. With actual singers and players, faulty intonation was found to be due primarily to a slovenly functioning of the ear. Such slovenliness is universal and is due to the absence of objective standards in training. When a singer or player standing in front of the tonoscope observed that he flatted by a given fraction of a tone, he was required to correct this immediately by sight. The correction took place with surprising rapidity

and to a high degree of precision. This was, of course, accomplished by using the eye as a check on the ear to establish critical hearing of pitch to the limits of the ear.

By the same means, it is possible to improve intonation in the singing of musical intervals. The singing or playing of the chromatic scale and diminished or augmented intervals is greatly enhanced by this visual aid. The teacher need not be present because the pupil is sent to the instrument and told to practice hearing and intonation until the tonoscope picture shows that a required degree of proficiency has been attained. It is like using a ruler in measuring the size of an object. Any of the pitch modulations that are not too rapid can be observed by this instrument.

One such instrument available in the laboratory studio can be used for class demonstration, the tuning of instruments, the comparison of pitch in different types of tone quality, the establishment of correct habits of pitch intonation and as an achievement test. The instrument can be used with the teacher present; but to be most effective, the pupil should be assigned a task and allowed to work independently by the hour, simply reporting achievements accomplished from time to time.

Among the fundamental exercises should be: first, the establishment of the habit of correct intonation of an isolated tone; second, the mastery of intonation in the natural scale for the fixing of intervals; third, the mastery of the chromatic scale for the same purpose; fourth, the checking of these skills for selected notes in the actual musical situation as in singing or playing a simple melody; and fifth, treating in the same manner the development of skills for artistic deviation from the true, as in the augmenting or diminishing of intervals and the performance of other artistic modulations in pitch. All these represent basic and positive acquisition of habits which may be mastered by the beginning student so they will function automatically at all levels of musical performance.

Such laboratory procedures represent the latest achievement for the facilitation of instruction in courses on ear training. They should be dovetailed with the best conventional exercises for musical achievement in a musical situation.

Advanced students or artists who are found to be defective in pitch control at certain levels in the register can be given the task of eradicating these faults. This can be accomplished by specific and persistent practice on one feature at a time, keeping a record of the progress

made. Each of the objectives in pitch control is mastered by itself, but the habits established become interlocking and the net result is precision in the hearing of pitch and mastery of its control. At the beginning of training, the student becomes clearly pitch-conscious and develops a critical attitude. As learning progresses, he becomes less and less conscious of the specific object, and thereafter the pitch control becomes automatic so that he sings and plays with precision in the artistic mood, conscious of the larger objectives of the art.

Seeing the Dynamic Aspects of Tone

One of the fundamental marks of musicianship is the mastery of the dynamic control of tones in all musical phrasing and interpretation. The student of this aspect of tone has been greatly hampered because he has had no defined terminology for intensity of tone, no objective standards, no units of measurement. As a result, he has been left groping in comparative ignorance and helplessness for this aspect of tone. Training for skills in dynamic control has been the barest rule-of-thumb procedure.

Performers, as a rule, are guided by their personal feelings of a vague satisfyingness in terms of loudness. They have a general conception of *pp, p, m, mf,* and *ff*, but these vary among individuals and in the same individual from time to time. Musical scores have had no basic references; musicians have had no unit in terms of which they could express degrees of modulations of loudness in musical phrasing, in determining the carrying power of different qualities of tone, or in the balancing of instruments.

But through the science of acoustics there has recently been developed the means of measuring loudness, standards of loudness, musically significant units of loudness, and scientific treatments of the factors which influence real or apparent loudness of a tone.

Practical interests in this aspect of musical performance are in their very beginning. So far as music is concerned, this is a virgin field. Students as well as their masters must be appraised of the new possibilities. The decibel is the new unit introduced for registering the intensity of tones. One decibel represents approximately the least perceptible difference in the loudness of tone that can be heard by the average ear. It is, however, standardized in terms of electrical units of energy so that it has a fixed value for all measurements in the dynamics of sound. Fundamentally, the decibel designates physical intensity or energy in sound; but in terms of intensity scales, it may

be converted into loudness scales, loudness being the musical correlate of physical intensity. Thus we can measure loudness in terms of physical intensity of tone just as we measure pitch in terms of the number of physical vibrations per second.

Our Dr. Reger has suggested (See author's *Psychology of Music*, p. 89) that under defined conditions we might start tentatively by adopting the following scale for a 75-piece orchestra in decibel levels above the threshold:

ppp	20 db
pp	40 db
p	55 db
mf	65 db
f	75 db
ff	85 db
fff	95 db

The establishment of scales is the function of acoustic laboratories or bureaus of standards; it is the function of psychology to adapt these to the musical needs. Scales are a fundamental requirement in all aspects of acoustics, as in sound-proofing and other acoustic treatment of rooms and in the abatement of noises, in the testing of efficiency of industrial instruments, and in a great many other aspects of sound production now becoming the object of scientific investigation for theoretical and practical purposes. Once these scales are established, they can be recorded for training purposes so that we can hear, think, and speak of degrees of loudness in terms of decibels, with an approach to the same precision that enables us to speak of pitch in terms of vibrations. Instruments may be devised for sounding tones in any desired degree of loudness. Within the last few years radio technicians have made great progress in standardizing and controlling degrees of loudness in tone.

For present purposes, it is not necessary to master all these technical details. The immediate objective is to make the student loudness-conscious just as he is pitch-conscious — to make him feel at home with loudness in the mastery of it, to form definite loudness habits, to objectify feeling-values for loudness.

The first essential for a training laboratory in this respect is a simplified output meter such as we see in use in all radio studios. There are many varieties of these, all relatively inexpensive. The essential requirement of an output meter for the training laboratory is that it have a dial on which, by the movement of a needle, the intensity of

tone registered through a microphone will be indicated in terms of decibels. It is a simple principle employed in ameters or voltmeters. The instant the performer sounds a note, he can watch the swinging of the needle over the decibel scale and observe how the tone rises in intensity, how it moves in crescendo and diminuendo, and how it fluctuates in steadiness. The process is as simple as seeing the time of day by observing the hands of the clock, and the instrument can be relatively foolproof.

On the analogy of exercises in pitch, exercises in the training for loudness should be organized: first, to make the student loudness-conscious and give him complete and verifiable illustrations of observable magnitudes in the dynamic value of tones; second, to train him in the production of a given loudness, for example the standard for *mf*, just as we train in the production of a given pitch; third, to observe the function and control of loudness as an element of rhythm or stress; fourth, to master evenness in loudness desired, crescendos and diminuendos, and forms of attack and release of the tone; fifth, to balance dynamic values of different instruments; and sixth, to master artistic deviations from loudness as in the intensity vibrato.

With the output meter standing on the piano like a metronome, a pianist can see for the first time the exact details of his musical phrasing in terms of intensity. This is most significant since the control of intensity is a key to artistic performance on the piano. The student can be assigned a task with the privilege of working by himself with the instrument and recording achievement since control of intensity is the basis for artistic achievement.

A musician who is not familiar with these recent developments in acoustics would be dumbfounded to see how helpless he has been in the absence of these acoustic devices for the hearing, understanding, feeling, and control of the dynamics of tone. It would be hazardous to predict what coming generations of musicians will be able to achieve through their acceptance of this type of device. The challenge to the musical educator today is to utilize this innovation for the refinement of musical performance just as he utilizes the face of his watch in telling the time of day.

Seeing the Temporal Aspects of Tone

The soloist is not restricted to metronomic time or to rigid adherence to the indicated rhythmic pattern in the measure. His artistic

deviation from the regular is the principal medium for his musical interpretation. Indeed, this artistic deviation is more difficult than rigid adherence to the time indicated by the notes. It rests, of course, primarily upon the fine feeling for time; but the execution of that time-feeling rests upon the development of a motor skill for the purpose.

The situation is quite different in group performance of voices or instruments. Much of the distress that the orchestra conductor has to suffer comes from those who cannot keep time or differentiate rhythmic patterns.

We can now take the student into a training laboratory and measure, first, his sense of time in hearing, and second, his natural capacity for performance in time. On the basis of each of these, discriminating selection may be made for admission to the group. The scores will carry evidence of various degrees of natural aptness and will reveal cases which should probably be discouraged due to lack of such talent. On the basis of each of these two talent ratings, training in the motor control of pitch may be instituted.

The best available all-round instrument for this purpose is the R. H. Seashore Rhythm Meter.[30] This consists of a phonograph disc fitted with a series of variable contacts by means of which any particular rhythm may be set up and sounded through a telephone receiver. The rhythmic action consists of the tapping of a telegraph key which sounds the rhythm in another receiver as performed. An ink stylus in circuit with the key makes a graphic record on a plain sheet of paper, cut to the dimensions of the standard disc and resting on it. On this paper, the standard pattern is indicated by reference bases as heard, and the pattern as performed is indicated by a stylus tracing on the paper. This tracing shows exactly how the performer succeeded in precision measured in terms of .01 of a second for any one or all members in the rhythmic pattern of deviation. If we desire to register the stress in addition to the time, the lever carrying the tracing stylus can be set to indicate degree of accent. One great advantage of this type of meter is that the record is preserved in permanent form and can be measured and analyzed at any time in full detail. Thus from a series of such records, a learning curve can be established.

The performer can see every item in the record as he hears it in his performance or he can make a series of trials covering, for example,

30 Studies in motor rhythm. Univ. of Iowa Stud. in Psychol., 9, 1926, 142-199.

ten measures; after each one, he can examine his record as an exact indication of his performance.

Such instruments can be adjusted for a variety of purposes, but I would suggest the following basic procedures with beginning students: first, measure the sense of time and the sense of rhythm; second, measure the capacity for keeping metronomic time and the natural aptness shown for precision in the performance of a simple rhythm; and third, with these measures of natural talent in hand, give the needed training for precision in keeping time and in the performance of rhythmic patterns with a series of two, three or four notes in the measure.

Seeing the Qualitative Aspects of Tone

Timbre is the most complex factor with which we have to deal in tone production. And training students of voice or instrument for timbre or tone quality represents one of the most helpless stages in the traditional development of tone production. Musicians have not had any objective standards or means of obtaining performance scores in timbre or sonance — the two factors which constitute tone quality. At the best, the teacher has tried to explain how to produce a tone through instruction in the various elements which determine quality of tone, and the instructor has sung or played his best examples of the goal to be reached. Granting that the models thus exhibited are good, which is rarely the case, these procedures still involve an enormous waste of time and seldom result in a high order of achievement unless the student, by luck or natural aptitude, happens to stumble along with some degree of success.

Within the last few years the invention of instruments available for a training studio has made it possible to reverse this process so that the student begins by accepting the specific goal toward which he is training, and, in working toward that goal, discovers for himself or is taught the essentials of tone production. Training begins not with exercises in tone placement, resonance and breathing (without a goal) but in the formation of a well-defined concept of the type of tone to be reached. The pupil is then in a position to appreciate the advantage of instruction in terms of controlled hearing and visual representation of the result.

One good approach to the use of objective records in teaching voice, available to all teachers, lies in the use of the phonograph to set up a good model tone. Try this experiment: Help the student select a

superior recorded song suitable to his voice and register, preferably in the legato style. Let him sing with the record played softly so that he can hear his own voice clearly — sing, sing, and sing in his prevate room until he begins to feel companionship with the master and becomes familiar with his objective and his own shortcomings. Then let him fractionate the task by alternating with the master voice in singing representative tones or phrases until it begins to be a real contest. Then is the time to step in and supplement the phonograph by the teaching of the standard techniques. New models may be used to emphasize specific needs. We have found that a fair trial of this method yields astonishing results in a short time. It is particularly profitable for the fairly advanced student for whom it becomes a corrective measure.

Where recording apparatus is available, it may be used to advantage in objectifying stages of progress so the student can hear his voice as recorded.

We have a variety of oscillographs and oscilloscopes which make the form of the sound wave visible. The presence of each and every partial in the tone is indicated by a characteristic deflection in the sound wave. But we must recall that the intricacy and the contour of the sound wave is not only as complex as the structure of the tone but is complicated by other factors so that it is not easy to identify each partial by immediate inspection of the oscillogram. To yield such complete details, it must be submitted to harmonic analysis. Yet it is quite possible and profitable to set up a sound wave from a singer or an instrument as a standard tone so that when the singer or player performs in front of the microphone he can compare his sound waves with the norm, the object being to approximate the sound wave to the norm. Thus the student continues to hear the model tone but uses the picture of the sound wave to magnify, as it were, and objectify the differences which might not be heard without the visual aid.

With instruments now available at reasonable cost and comparatively simple to operate, one can instantly recognize the different vowel patterns, degrees in richness of tone, characteristic brightness or roughness, and the result of various types of tone placement. A student's oscilloscope makes a most fascinating instrument for musical aid in practice. If the object is to correct a particular fault, the pattern can be set in such a way as to accentuate that fault by contrast with the desirable tone. The fundamental principle involved in training with the oscilloscope is the refinement of artistic hearing by iden-

tification of specific factors which modify it, such as changing the amount of energy in a given overtone, changing the position of formants, or modifying the richness of tone.

The possibilities for developing creative exercises with the aid of these instruments are practically unlimited. Suffice it to say that if a student is given a chance to use these aids and has natural ability, he will be motivated to recognize the possibilities of their use for the acquisition of a high order of skill in a minimum time.

We are so familiar with the extraordinary expansion of the musical world which has come in through our confidence in, and encouragement of, phonograph and radio that we grossly underestimate the step that has been taken. The first thing now needed in training voice and instrument teachers is to convince them that corresponding improvements in musical training can be made where they are willing to accept instrumental aids in scientific analysis of the training situation. The recommendations here made are in the nature of a prediction but they emerge from sound scientific bases for operation in the laboratory and the development of instruments. The situation is so new that it has not come to the attention of musical educators. But time works wonders.

CRITICAL TRAINING VS. ARTISTIC PERFORMANCE *

Psychology of music has done much to clarify the distinction between the attitude in learning and the attitude in performing. The finished pianist, for example, should play in an all-absorbing artistic mood, free from awareness of specific details. The learner should train in a scientifically critical attitude, clearly aware of the mastery of one specific technique at a time. Failure to recognize and act upon a radical distinction between the artistic mood and the mood essential to the mastery of technique in training accounts in large part for failure in artistry and waste in time, energy, and perfection of training for musicianship.

> Music must flow as an inspiration from a soul full of music in the artistic attitude, which means *the welling up of the unconscious forces.* The most genuine appreciation and the richest expression of music does not arise when impeded by a technical consciousness, when hampered by thought of principles, rules and restrictions. Music is an impressionistic art and cannot be created, performed, or most deeply appreciated in the spirit of formal reflection. On the other hand, one must have been intensely conscious of technique, must have known laws, must have isolated element after element for intensive study, all severely intellectual, cold, and quite free from the

* Reprinted from Educational Music Magazine, September-October, 1941, p. 4-5.

artistic impulse, before control of these can become so automatic as to drop into the background of consciousness.[31]

The virtuoso, or the accomplished amateur, at the piano cannot play with full musical feeling in artistic competence so long as he is highly conscious of elements of technique, fact, theory, or attitude and his mind wanders to: This note, this key, this finger; degrees of loudness, accent, volume; precision in metronomic time, tempo rubato, elements of rhythm; range of tonal timbre, consonance, quality; mechanisms for controlling time, intensity, timbre; theories of phrasing, asynchronization, emphasis; functions of keys, pedals, means of blending; forms of balance, contrast, unity; principles of artistic deviation from even loudness, metronomic time, pure tone; imitation of teacher, favored artist, smart stunt; fear of forgetting, audience, critics; consciousness of self, environment, printed score.

These and a hundred other elements of skill, facts, theories, desires, and designs, which take the form of distraction, must have been mastered, each in turn and in a larger whole and in recurrent cycles of renewal, until they have become serviceable habits relegated to the subconscious so that they function automatically without distraction in the artistic environment.

For the creative writer, alphabet, spelling, grammar, rhetoric, and handwriting function automatically, and his mind is free in the development of a creative idea. So the musical artist must have organic command of the technical elements in his performance in order that his creative interpretation of the music may flow in spontaneous musical emotion from the depths of his personality.

With this, the student attitude stands in striking contrast. He cannot learn effectively, save time and energy, and reach the highest proficiency in training unless he has acquired: Evidence of native talent, love of music, will to work; mastery of sight reading, posture, touch; proficiency in ear training, serviceable memory, vivid musical imagery; precision in dynamic, temporal, and qualitative control of tones; scales, arpeggios, musical figures; techniques for cognitive, affective, and motor skills; knowledge of acoustics, psychology of music, musical esthetics; artistic license for deviation, interpretation, self-expression; freedom from consciousness of self, fear, frustration; development of individuality, creative power, love of the art.

These and a hundred other elements of musical technique, musical

31 Seashore, Carl E.: The psychology of musical talent. New York City: Silver Burdett, 1919, Pp. 259.

form, musical skills, and musical knowledge must be approached in a distinctly scientific and critical attitude under critical guidance for the clarifying of concepts, identification of factors, and mastery of skills through specific drills. The learner must know specifically what he is to acquire at a given time, how to isolate the specific factor for systematic drill in appreciation and action. He must have critical guidance and means of evaluating progress. He must be conscious of himself, his instrument, his task, and techniques for the attainment of mastery. He must concentrate and drill on one objective until control of it becomes a habit which sinks into the subconscious, becomes part of his organism, and operates automatically in the musical situation.

In analyzing the musical selection into performance problems which should be relegated to the training period, teachers are in danger of thinking only of motor skills involving elements of precision and speed. The above analysis is designed to show that essential as these are, the issues for mastery through specific practice pertain to the recognition of musical facts, musical theories, musical hearing, musical feeling, and musical evaluation. Countless numbers of these must be discovered, given individual attention, and, if approved, made matters of habit as training proceeds.

But when shall the cultivation of the artistic mood begin? It should be encouraged from the earliest stages of training and be pursued through all stages of the training, even throughout the professional career. It is in itself one of the elements of performance which must be developed into a habit through specific exercise so that the player naturally falls into it, oblivious to details, when performing for his own pleasure or the pleasure of others. Every practice period should culminate in a performance period, however brief. The ability to throw himself wholeheartedly into the artistic mood is one of the most difficult things to learn. He must learn to make a radical shift at will from one mood to the other. The effectiveness of the training hinges largely on his ability to make a clean-cut shift.

The young pupil needs first of all a sympathetic listener. From the very first he should learn to appreciate and love his own performance in the artistic mood through moments of rehearsal. He should try himself out on his admiring friends. As a unit in the training, this becomes a process of checking in on his accomplishments after a period of rigorous and critical practice on the details scheduled for the day. Such foretaste of real musical achievement furnishes the most effective motivation for willingness to settle down to the hard

work of mastering technicalities, applying musical knowledge in specific instances, and developing a feeling for artistic values.

For two generations we have lived through a period of controversy between the proponents of the technical approach and the rote approach of unanalyzed playing and singing in the public schools. The general trend among music educators is to recognize a place for both and to put the technical approach in the foreground gradually as the need of it arises with maturation and the unfolding of a serious plan for musical education. The issue becomes grave when effective artistry is sought and becomes a real goal. Thus the controversy is dissolved.

Fortunately, we are not restricted to the employment of dreary exercises, isolated from musical content, but can often make use of good music by picking out for specific drills any point which presents difficulty. By isolating it for effective drill, the learner becomes clearly conscious of the difficulty and the necessity for developing precision, speed, general expressiveness, and art form. Indeed, this rather than listening to a long performance, is the function of the teacher. Thus a feeling for the specific technical feature in the actual musical situation is developed. Not to do so is unforgiveable slovenliness.

This is not merely "learning by parts" as opposed to "learning by the whole." Even the smallest musical part may involve a number of features each of which calls for mastery. Effective training begins with analysis, making the learner clearly conscious of technical features involved in the phrase, the measure, the individual chord, or the single note.

As a boy in a country school, ambitious to "spell down the teacher" in the spelling schools then prevailing, I made two observations which have since then become fundamental principles of my education. The first was that as I knew how to spell most of the words in the spelling book which was used, I should waste no time in learning those words; the second was that I should mark all the words which I had missed or gave trouble and study those effectively. By this means I mastered the spelling of every word in the book in a very short time and found myself the champion speller in the county. My competitors as a rule wasted time and lost in proficiency by rote practice from the beginning to the end of the book, not knowing where their difficulties lay.

These two principles apply to music: There is not much object in learning what you already know; you can save time and gain proficiency by first discovering what you don't know and then tackling

each of these factors intensively in turn. The main thing is the analysis and identification of difficulties. Many of them are solved by merely having attention drawn to them clearly and emphatically with the purpose of mastery in mind.

The crime of the day in musical training is the mere playing of a part or a whole by rote, trusting that mastery will come with practice without knowing what the specific objectives involved are, or what it is that must be learned. The demand for the analytical approach pertains even to the smallest musical part, such as the timbre of a single tone, and places responsibility for injecting into the part all the features which are essential in order to make it musical.

In good teaching, the pupil is now required to analyze the score of a new selection in a sort of preview before attempting to play by organizing musical units which are to be grasped as wholes and, within these, identifying features which present difficulty. The learning of a repertoire by a competent musician is best effected by an intensive preview in reading the score and analyzing it musically in great detail before attempting to memorize by actual playing. This is learning by thinking.

What I have here attempted to illustrate in regard to the development of musicianship in the piano applies with equal force to the mastery of other instruments. It applies especially to the development of the singing voice. Voice trainers and voice students are the greatest sinners in their failure to recognize these principles.

The reader may say there is nothing new in this. That may be true for some educators; but in the actual practice of teacher, pupil and performer, there is cause for alarm. It is a call for reform, a cutting criticism. Some of our leading artists on the stage are just taking potluck, trusting natural talent and inspiration but oblivious to the elements of musical artistry which should have been discovered, developed, and integrated in the training period.

I am reminded of the story about the Presbyterian minister in Pittsburgh who preached the same sermon seven Sundays in succession, and when called to task by his board, he expressed surprise, and said, "Have you begun to practice it?"

SCIENCE IN MUSIC *

Music draws upon a number of basic sciences, such as mathematics, physics, physiology, anatomy, genetics, anthropology and general

* Reprinted from Science, September, 1941, p. 117-122.

psychology, in the light of prevailing musical theory and practice. It has become the function of the new applied science, the psychology of music, to integrate all these contributions and fit them as a unified function into the theory and practice of music and to initiate specifically designed experiments for the solving of musical problems. The initiative has been taken by psychologists; but as knowledge of the scientific aspects becomes a part of artistic creation and skill, this work of integration will be taken over more and more by musicians, and the distinction between the scientist and the artist will tend to disappear.

On the occasion of a football game at the University of Oklahoma in 1939, I saw seventy-seven marching bands on parade. This represented only a section of the state, and the dust bowl state at that. It meant that music is being taught in the public schools of that state on a surprisingly large scale. Out of these popular bands in showy uniform will come a host of musicians of all kinds and degrees. Music is in the public schools to stay on a large scale. Music in America is in the air, literally and figuratively.

In the last ten years, the State University of Iowa, as one of the American universities which have taken cognizance of this problem, has conferred twelve doctor of philosophy degrees and one hundred ninety-seven master of arts degrees in music. The master of arts is coming to be required of all high-school music teachers. From kindergarten up to the graduate school, music has been taken in with the three R's and their derivatives. As a result we have such relatively new terms as "music educator" and "musicology."

For a certificate to teach music, the candidate must ordinarily be certified for courses in general psychology and educational psychology; and a third requirement, the specific psychology of music, is fast coming in through our teacher-training schools.

In recent years the development of the Acoustical Society of America has brought about a revolution in musical thinking. Research in musical acoustics is being put on a rigidly scientific basis and is making great progress. There is an awakening interest in what is called musicology, the science of music, which has many branches, one of the most active of which is the psychology of music.

In view of this new demand and the new possibilities of a scientific approach to music and scientific foundations for musical education and musical theory in preparation for the teaching and study of music, it is time to inquire, "What can psychology do for music?" *

* When I was completing a series of thirty consecutive articles on the Psychology of

From the time of Aristoxenines and Pythagoras, there have been two attitudes toward music: one is the purely impressionistic attitude of the musician who is not interested in explanations but merely in results as judged by his unaided ear and speculative mind; the other is that of the scientific inquirer, like Pythagoras, who asked, for example, "What are the reasons for the musical scale, and what are its limitations?" The first is the easy and laissez-faire attitude; the second is a critical and scientific attitude which made no great progress until the beginning of the renaissance. Its first prominent organizer, Helmholtz, digested accumulated material from all sources and made fundamental contributions through his laboratory researches, discussed in his epoch-making volume, *Die Tonempfindungen* in 1862.

Psychology as an experimental science had its beginning only fifty years ago, and in the first half of that period, showed no interest in music. Thus the scientific approach to the understanding and mastery of music is relatively new, and antiscientific musicians are still with us in large numbers.

Psychology gives us a workable insight into the nature of the musical mind and thus lays foundations for the classification of events in musical experience and behavior and for the development of a scientific musical terminology.

The psychology of music is the science of musical experience and behavior. A general knowledge of the structure and function of the musical organism is therefore one of the first requirements in a scientific approach to the study and mastery of music. It helps the student understand what specific features he is dealing with in learning and performing and furnishes the essential basis for the orderly arrangement of observed facts. For example, we learn that the sound wave as the exclusive source of musical tones has only four basic variables; namely, frequency, intensity, duration and wave form. And on the basis of that, it has been found that the musical organism must have four corresponding capacities for hearing all music; namely, the sense of pitch, the sense of loudness, the sense of time and the sense of timbre. This conception simplifies the understanding of the nature

Music in the *Music Educators Journal*, the editor, recognizing that each of these articles had been an actual contribution to music from the psychological laboratory in the attempt to show what psychology is doing for music, asked me to generalize the series by answering this question. My answer was in twelve statements, which are repeated here in italics. These statements do not mean that psychology has accomplished all these things, but rather that the way has been paved. Nor does it mean that these are the only things psychology can do, but the items listed are limited to those with which I personally have had first-hand and comparatively large experience in the psychological laboratory.

and function of the musical mind in that each of these four basic functions appears in such complex musical forms as harmony, melody, dynamics, rhythm, volume and tone quality. It has been shown that all our musical memory, musical imagination, musical thought, musical feeling and emotion, musical action and musical composition may be expressed in these four terms. Thus the classification vastly simplifies the task of the musician and makes the problems of appreciation and performance concrete and specific. The understanding and description of musical design in composition, all the forms of musical expression of feeling, all the techniques in ear-training, all the analyses of musical appreciation, all deviations from the true and regular in artistic forms and all descriptions of types of musicianship and of music in general hinge upon a clear insight into the nature of the functioning of this type of classification. Yet this is but one aspect of classification which the psychology of music contributes to the understanding and description of the musical mind in action.

It organizes the scientific description of musical tones and the means for producing them.

Psychology enables the musician to think in orderly, specific, describable, repeatable and verifiable terms. This is all new to the traditional nonscientific musician. For example, he is interested in tone quality. But what is tone quality? What is its relation to other attributes of tone? What are its determinants? What are the limits, possibilities and means for its mastery? Which, if any, of the accretions of scores of fantastic names for tone quality are significant, definable and usable? These are all psychological questions with a musical meaning which may be taken into the laboratory.

One element of tone quality is timbre, but until very recently no music book revealed an adequate understanding of this concept. Definitions were often meaningless, and a waste of time and efficiency in teaching the mastery of timbre has been atrocious, largely because neither teacher nor pupil knew what it was that he was to develop and did not have any objective standards for orientation. The French pronunciation added to the mystery. Another element of tone quality is sonance. We had no name in music for this vital concept of tone quality until about fifteen years ago. Now tone quality can be explained in terms of timbre and sonance to satisfy the members of the Acoustical Society of America, the musicologists, the intelligent teachers and students of music and scientists in general. Discriminative hearing and appreciation and mastery in the control of tone quality

rest upon a correct terminology and insight into the nature of the concept.

The musician can now look at the graphic picture of the tone spectrum of his violin and the graphic performance score which is recorded with a camera and shows in minute detail exactly how he performed in a given rendition. To accomplish this, psychology accepts the physicist's account of tone production as exemplified in various instruments, the physiologist's account of the vocal mechanism and the human ear, the geneticist's theory of inheritance and development, the anthropologist's account of evolution in the human race and the psychologist's account of principles of hearing. Each of these contributions thus helps the musician to know and describe a certain characteristic of voice or instrument and analyzes and specifies the best means for artistic tone control and the acquisition of musical skills. To facilitate this for experimental purposes, tone generators are now available which enable us to produce any kind of tone desired according to specifications and to describe such tones quantitatively. Applied science can now improve the violin or any other instrument, build entirely new models or effect new ensembles of instruments.

It gives us an orderly insight into the nature, scope and limitations of musical hearing and appreciation.

The child says with satisfaction, "I see with my eyes and hear with my ears." That attitude, until recently, satisfied many a student and teacher of music. But there is now a very elaborate and serviceable experimental psychology of hearing, both pure and applied, for which we find countless applications in the hearing, appreciation and performance of music. The musician is now becoming interested in knowing and being able to state exactly what it is in the musical tone that he hears, appreciates, tries to perform and intends that the listener shall hear. He finds available an elaborate and technical system of laws of hearing, of which the most important are the laws of illusion in hearing. He finds that if it were not for the operation of law in illusion there could hardly be any real music. He finds that the relation between the physical sound and the sound as heard is not 1:1 and that a series of conversion tables for this relationship are of vital importance in hearing. He finds that the observation of acoustic principles determines the carrying power and the pleasantness or unpleasantness of his tone. His understanding and artistic rendition rest upon observance of these laws. The composer and the performer must be guided by definite laws of phonetics and acoustics. Musical hearing

and musical criticism must take them into account. In other words, the incoming insight, interpretation, description and mastery of music hinge upon the command of principles of hearing; and the musician finds that musical education is in large part a systematic training of a discriminating ear.

It enables us to analyze and evaluate musical talents as a basis for guidance in musical education, vocational and avocational.

Musical talent is inherited in various kinds and various degrees. There is not one, but a hierarchy, of musical talents, many of which can now be analyzed clearly and measured with precision. In this equipment, nature is prolific. Education and refinement build upon selected native capacities; but most frequently a large part of this inherited endowment is lost for want of cultivation.

The magnitude of individual differences is conspicuous in music. Yet the problem in music education is to deal with each individual difference with proper recognition of the total personality in the total situation. One of the unfortunate fallacies promulgated by many music teachers is the idea that, while many children inherit a musical mind, it is their function to develop it in those children who have little or no such inheritance. But when the public school music teacher now makes a survey of musical talent in the school and finds that of two equally intelligent pupils one may have more than one hundred times as fine a sense of pitch, sense of rhythm, sense of time or sense of timbre as the other and that these are relatively independent variables so that a pupil may stand high in one and low in another, he faces a stubborn fact which he can not ignore in selecting instruments, registering pupils for training, interpreting success or failure and laying foundations for praise and blame.

It has been found that in the human races of the world to-day and in the various culture levels of civilized people, there is but little difference in the average of the elemental capacities for musical hearing; but within any such group, there is an extraordinary range of difference among individuals. There is as wide a distribution of the gift of music among the primitive South Sea Islanders as there is in the families of the social register; and in both groups the highly gifted are relatively rare and the non-gifted are in abundance. When we find that these differences in capacity are fairly independent of age, intelligence, training and culture or racial origin, we face new problems in music. Native talent is the capital which it is the business of the music educator to invest. He must therefore know what it is and

how to make the best investment. Psychology has furnished the methods and means for such measurement, not only at the sensory and motor levels but also at the higher creative levels.

It furnishes the technique for the measurement of musical achievement by the analysis and objectifying of goals as a means of motivation in training.

The techniques developed for the measurement of musical talent are now carried into the field of the analysis and measurement of musical achievement. It has become possible to set up definite musical objectives as specific goals of achievement in various stages of training and to measure progressive achievement in the work toward these goals. Thus a pupil is furnished a check list of specific concepts, skills and critical judgments which are to be acquired, and may enjoy the privilege of knowing in specific terms what progress he is making from time to time. This is a powerful element in motivation and the attainment of efficiency through instruction. This organization of scientific measurement of musical achievement is going to revolutionize the musical curriculum. There will be a general housecleaning for discarding the non-essential, the undefinable and the incongruous; and the music educators are now joining in cooperative movements to determine the minimum essentials and the order of their development in terms of scientifically defined concepts.

It enables us to organize musical training in terms of a growing body of principles in educational psychology.

Educational psychology has revolutionized teaching in all other public-school subjects. Music educators and psychologists are now attempting to glean nuggets from the current literature on the various aspects of the psychology of learning in order to select and organize those general facts in educational psychology which have a bearing on the art of instruction in music. Music teachers are fast joining the ranks of those who conduct psychological experiments in the actual musical situation. It has been the function of psychology to stimulate and facilitate this movement.

It paves the way at all levels for principles of musical criticism and a logical award of praise and blame.

Historically, musical criticism has generally been impressionistic and unscholarly. But it is no longer satisfactory to fill the music columns with laudatory or condemning slush, popularly conventional, prejudiced, often subsidized. The psychology of music has begun to pave the way by furnishing the tools for logical criticism and discrim-

inating judgment in terminology standardized for the art. Considerate and judicious criticism is one of the most promising incoming means for motivation or rightful discouragement from the child in the elementary grades to the professional on the stage. It is not only pedagogical but humanitarian to recognize individual differences in the degree and kind of musical capacity at all levels in the award of praise and blame. We can not expect equal achievement from all the children in a given grade in school; and in assigning credit for work, the modern teacher faces a new problem — the attainment of a fair balance in giving credit or discredit for achievement in relation to capacity for achievement and specific outstanding fortes and faults.

It makes possible the use of performance scores for the detailed analysis and quantifying of artistic elements in musical performance.

The greatest single contribution made in the recent advances of the psychology of music lies in the development of musical phonophotography and the invention of the graphic musical performance score, based on the objective recording of individual sound waves in the musical tone. The phonographic recording had to be supplemented by a series of phonophotographic processes. The musician can now go into the recording studio and perform with voice or instrument where, in addition to a permanent phonographic record, a series of synchronized cameras reproduce every aspect of each individual sound wave so that each note can be reconstructed in minute detail much finer than the ear can hear. This recording may be done in a dead room, which eliminates from the musical performance all those characteristics which are due to extraneous sounds and the acoustic characteristics of the music room. Thus in the time that it takes to sing a song, whether it is sung on the stage, in the radio studio or in the laboratory, we obtain a moving picture record which contains thousands of items of musical significance.

But the mastery of this type of recording revealed the necessity of a new type of language for musical performance. This has taken the form of what is known as a performance score, in which the actual rendition of each note is graphed in such detail as may be desired in terms of clearly defined characteristics of the tone as rendered. This graphic performance score is a brand new language with a systematized series of symbols representing defined concepts for musical performance quite analogous in its significance to the language and symbols of mathematics or biology. In terms of such a performance score,

any specific element in the character of the performance may be isolated for analysis and measurement. The musician will see revealed in the score an astonishing number of features of which he was not aware. The interpretation given by various artists may be compared and criticized, and new features in the phonographic record for the ear will be recognized when they have been revealed by the cameras. For the preservation of primitive music, for the criticism of great artists and for educational purposes, the resources of the performance score are inexhaustible and open up a new area of interest and proficiency in music.

Individuality in the art of musical interpretation lies largely in artistic deviation from the true, the rigid and the uniform as represented by the musical score. The performance score represents precision measurements of all forms and degrees of artistic deviation expressing artistic license, judgment and skill.

It enables us to set up norms of prevailing musical achievement and to show by experiment how these norms for attainment could and should be refined.

We do not have and do not desire fixed standards or norms in any element of musical excellence. There must be room for artistic individuality, and there are countless elements which may contribute to the goodness or badness of a voice or an instrument. But the psychology of music has introduced techniques, especially through the use of the performance score, for showing what the style, the tendencies, the limits of variability and other characteristics are in any element of the best musical performance of to-day. There is a recognizable limit of tolerance within which the artist must be restrained. For example, when we take such a debatable and often unbearable feature as the vibrato of the singer, norms can be established to show that every good singer sings with a vibrato on practically every note intoned, whether he hears it or intends it or not. It is an inaliable element of goodness in voice. On an average, the twenty-five best recognized singers of to-day have a pitch pulsation of approximately a half-tone, which seems unbelievable because it is not heard as such. They have an average rate of pulsation of about six and one-half per second, which tends to take the form of a smooth sine curve and may be in pitch, intensity or timbre and frequently is in all three. Excellent but untutored primitive singers have approximately the same kind and degree of vibrato as do recognized musicians.

But these norms of prevailing excellence in voice can readily be

refined. Norms of average performance for violin and other instruments have been established. If we assume, for example, as is generally conceded, that the violin vibrato is more musically acceptable than the prevailing voice vibrato, we can take the best violin vibrato as a model for the establishment of a more ideal norm and proceed in a short time to refine the vibrato of a singer to something like the violin norm, which is barely half as conspicuous as the prevailing vocal norms. Psychologists have shown how this can be done for any pupil or any artist now on the stage. It is difficult to imagine what a tremendous advance in the art of singing such a modulation of the prevailing vibrato among singers would be if such reformation of the stage were attempted seriously. It would ban the tremolo, which is simply a bad vibrato, and would contribute vastly to the beauty in flexibility, tenderness and richness of tone. It took psychologists to show what the vibrato is, how bad the prevailing vibrato may be and how it can be improved.

It furnishes instruments and techniques which will shorten the time of musical training and yield a higher precision and mastery than is ordinarily obtained.

Thanks to the extraordinary development in the recording and transmission of sound on principles involved in the radio, we are now in a position to equip the music studio, both public and private, with training instruments. Skill in pitch intonation is gained by training in front of an instrument which shows instantly, down to a hundredth of a whole-tone step, the precision, artistic deviation or degree of error in singing or playing in pitch. The pianist can practice various principles of artistic dynamics in phrasing by keeping his eye on a dial which registers all dynamic changes in terms of defined units of intensity of tone. The student who has difficulty with rhythm can go through rigorous exercises on model patterns and see how he conforms to these patterns either in terms of time as measured in hundredths of a second or of stress as measured in terms of decibels. The most difficult feature which both vocal and instrumental students have to master is that of tone quality. And here again one can have the advantage of an instrument which shows the wave form of his tone the instant it is sounded in such a way that he can compare it with the desired norm, and can thus practice with his visual aid to extraordinary advantage. In short, music is falling in line with industry and war in turning to mechanized features as instrumental aids; and it can be said conservatively that where this is done, we can predict an ex-

traordinary shortening of the time of training for a specific skill and a hitherto unattainable degree of precision.

It enables us to record, preserve and interpret music in all forms of historical interest.

The musical anthropologist now faces unlimited facilities for accumulating a wealth of historical material in music. The phonograph recordings are now good, and the acoustic recordings with moving pictures now have sufficient fidelity for scientific purposes. Portable moving picture machines are now available in all parts of the world and the producers and newsgathering interests are glad to cooperate with scientists. The Hollywood producers have under consideration a plan for sending musical and linguistic anthropologists into primitive fields a year or two in advance of their proposed filming. Such an expert could thus make a preliminary scientific survey of the prevailing types of music and the performers which would be available for the filming industry and for purely scientific purposes. The industries will be repaid by the spirit of cooperation from the natives which can be cultivated. The field camera will be at the free disposal of the musical anthropologist for the recording of such scientific and artistic features as he may have found significant for the science of music. The sound tracks may be accompanied by significant moving pictures of dance and other forms of dramatic action which are essential to vitalize the music. In short, the problem of how to record primitive music is solved. The problem now before us is to find workers who can analyze and utilize that material for the history, science and art of music. The phonographic and film recording of the best music of to-day is of such high quality that any artist will be glad to be immortalized by the faithful preservation of his music through recordings. Here, again, we already have unlimited source material for scientific analysis, a gold mine for musicologists. One who was at work on the collection and preservation of music three or four decades ago is in a position to appreciate the fabulous advantages the collector of to-day has over the collector of twenty years ago.

It furnishes the groundwork for a future science and philosophy of musical esthetics.

Musical esthetics of the past has been largely a speculative armchair product. With the coming in of facilities for measurement of musical values which should constitute the groundwork of esthetics, we enter upon a radically new era in this field. Armchair theories can now be put to experiment to be verified or discarded, modified or simplified.

This applies particularly to all aspects of the nature and significance of scales and every other aspect of intervals, to all studies of the evolution of musical feeling, to all aspects of the evolution of musical values, to the fundamental concepts of the power of music and to theories of goals to be attained. The study of such total problems can now be fractionated in the scientific attitude of dealing with one specific element at a time; such as some particular phase of harmony, balance, symmetry, resolution or musical license. For this purpose, a radical revision of terminology for the scientific and philosophical discussion of musical esthetics must be introduced.

The scientific procedure in a new and unlimited field of this kind is a slow and arduous process and in any generation, mere beginnings can be made. But, as in the introduction of scientific methods in the classification of plants and animals and the interpretation of their complete life histories, once the scientific attitude is made possible the purely speculative will gradually become less and less acceptable as a final solution. More progress toward a scientific approach to musical esthetics has been made in the last twenty years than in all preceding history.

Coda. There is, of course, a very large body of scientific principles and means of progress developed by musicians themselves in creative experimentation and thinking within the art. That is taken for granted. The features here discussed are drawn from contributions in current science which have a bearing on music. For the purpose of concrete illustrations, it is limited to features with which the author has had first-hand acquaintance; many other scientific approaches deserve mention. The aim has been to present a point of view and a comparatively new frame of reference for scientific thinking in music.

What is here indicated for music applies in principle to all the other fine arts, especially those of language, drama, poetry and dance. The more we rise into a consideration of the common elements of all artistic creative power and the assimilation of art in daily life and philosophical thought, the more we become aware of a common ground of interest, appreciation and cultivation of the scientific spirit in all arts, both pure and applied.

Chapter VI

PSYCHOLOGY IN SPEECH

ORIGINS

Under the general head of speech, we may group a number of new approaches to the science of fine arts which had a common origin in the psychological laboratory. Some of these have developed into highly organized divisions through acoustics, phonetics, dramatics, poetry, linguistics and education, together with clinical principles and services. The points I wish to emphasize are: (1) the taproot of all these scientific findings and approaches is found in the psychological laboratory; (2) the central psychological laboratory is shared by all engaged in research in these fields from a scientific point of view; (3) the personnel of the staff is intimately interrelated with the personnel in psychology and the differentiated fields; (4) while the applied side of the work is obvious, the spirit and attitude of the approach rests upon pure science and builds on research; (5) success on the practical side is due largely to rigid adherence to the principles of experimental psychology; (6) psychology has been greatly enriched through the generous response of the representatives devoted entirely to the art side; (7) the adoption of the scientific approach to this subject explains in large part the generous support obtained from outside foundations and the great influx of advanced students who carry much of the burden work as apprentices; (8) that both on the theoretical and the practical sides, music and speech have common origins, problems, techniques and goals.

While I shall speak of the institutional development of such units as the theater and radio, which seem rather remote from psychology, my aim is simply to trace origins and influences in the give-and-take between science and art.

In speaking of psychology as the representative science for art, we must bear in mind that its function is to integrate and interpret the contributions that come from many other sciences; such as, anthropology, physiology, anatomy, physics, and acoustics, and due credit should be given to these sources. It is not easy to trace the connecting

links in the evolution of the idea that there is a place for science in the fine arts, but we have here some striking illustrations of its realization.

I am particularly anxious that this attempt to trace origins and purposes from psychology shall not detract from the history of these developments, which is certain to be written from the point of view of the arts, or from the local and national acclaim so well deserved. I am happy to take this occasion to acknowledge with gratitude the psychologists' obligations to the representatives of the arts who have shared in the division of labor from the beginning of this formative period. Joint projects fall into two major divisions; first, approaches to the science of the art of speech, and second, speech pathology. The latter subject will be treated in a separate section.

THE DOCTORATE IN SPEECH

About 1920 the head of the department of speech, Glenn N. Merry, realized that a demand for speech education of the doctorate order was progressing very rapidly and that he must make further preparation to keep apace with it. He had been greatly stimulated by the advances made in the psychology of music and had kept in close touch with developments of research in the psychology of speech without any reference to the department of speech. We had, for example, Miles' *Measurements of Pitch Control*, Erickson's *Systematic Analysis of Voice as a Preparation for Experimental Procedure*, Root's *Pitch Patterns and Tonal Movement in Speech*, and Metzger's *Study of the Vocal Cords*, all of which had made significant contributions to the psychology of speech as a branch of applied psychology. Merry, therefore, took a year's leave of absence and came to the department of psychology to work for his doctorate on the general theme of objective analysis of principles of oratory. For this he developed an improved form of the Scripture graphic speech recorder, and analyzed a number of orations on the analogy of principles of analysis developed in the psychology of music.

When he returned to the department of speech, he proposed a plan for offering the doctorate in speech on the analogy of well-established departments. At that time there was no good precedent for that in the country, and the department in itself was not strong enough to justify it. As dean of the graduate college, and in the light of my experience of breaking down barriers for psychology, I could at that time see only one way to give the degree in a subject like speech. That was to

build up relationships with allied departments and personnel in the work so that, for example, the work in anatomy would be taken under an anatomist, psychology under a psychologist, physiology under a physiologist, dramatics under a director of art, education under an educationist, statistics under a mathematician, and acoustics under a physicist. A candidate for the doctorate in speech should have fundamental training in all its approaches. It was also understood that the candidate should be allowed to write his dissertation under the direction of an authority in any one of these fields. The job left for the professors of speech was to teach and direct research, both critical and creative, in those fields in which they might specialize; such as, oratory, phonetics, or dramatics.

At this juncture, Merry went to Harvard for further graduate study and E. C. Mabie was put in charge of the department. Mabie had had no advanced training in laboratory psychology but saw very clearly the possibilities involved in my plan and entered enthusiastically upon a program of developing the department along these lines, largely in co-operation with psychology, his own field being dramatic art. This broadening of the base for the department immediately gave it great strength and attracted students of high quality into graduate work. Naturally, since methods of acoustics and their application, and to some extent phonetics, had been developed in the psychological laboratory, it was agreed that the department of speech should have full privileges in sharing this laboratory for research, and candidates for the doctorate who approached speech from the scientific side would be largely under the direction of a psychologist. Here came in such men as Metfessel, Tiffin, Lewis, Fairbanks, and Cowan for pioneering leadership in the conduct of research. In planning research projects, special attention was given to the effort to evaluate all forms of transfer of developments in the psychology of music in so far as they could be applied to the psychology of speech and linguistics.

With the work of Metfessel came our development of photographic procedures to take the place of the graphic method followed by Merry. This immediately led to great expansion and a variety of techniques, opening up new possibilities for ready and accurate measurement in speech and music. Here came the phonophotostrobograph and a variety of oscillographic techniques leading to the studies of harmonic analysis.

It was recognized, as we have seen, that the equipment needed for

scientific approaches to speech was exactly the same as has been needed and already considerably developed in the science of music. Both disciplines deal with sounds: sounds in speech have the same attributes as in music; the techniques in measurement are identical; many of the principles of art are the same; and the qualifications for phonetic and acoustical studies in the two subjects are the same. As we approach the higher levels of mental activities involved in the two arts, they come closer and closer together — as in the evaluation of creative ability, the interpretation of the esthetic attitude, the integration of artistic skills in the artistic mood, the basic theories of origins and heredity, and the purposes and goals of the arts. Thus one section in the department of speech suddenly stepped into a highly equipped laboratory with adequate personnel and interests for the conduct of scientific research.

This movement was unparalleled and at once gave Iowa great distinction in this field. The professors of speech proper specialized in oratory, debate, dramatic writing, and production, and developed technicians in the various fields. The spirit of research which originated in the psychological laboratory spread into these and other approaches and created a distinctly scientific atmosphere in the approaches to artistic speech. The associations of this branch of the department with speech pathology, which was organized on the same basis, again strengthened the department.

The policy of integration with other departments was extended in various directions leading to mutual advantages and enrichment. This concept of co-operation from various departments in sponsoring speech was original at that time and has justified itself many times over. It has spread into other disciplines, notably physical education, child welfare, medicine, and education, and we can now say that the doctorate in speech is fully as dignified and academic as the doctorate in any of the old sciences and arts. Through the creation of this type of doctorate, we can easily trace some of the wholesome developments of the concept of graduate work in the University. By 1940, 35 doctorates and 348 master's degrees had been conferred in speech, and several degrees had been conferred in allied departments due to the policy of integration.

Logically these two psychological approaches which opened up two new fields for graduate work in speech might well be classified with psychology as forms of applied psychology. As a matter of fact they have been so administered for practical purposes, almost entirely so

in regard to budgetary matters and partially so in organization and control of research. The fact is that through this procedure, departmental barriers between speech and psychology were practically obliterated, and business in general was done on the basis of gentlemen's agreements. This had great advantages by avoiding duplication of equipment and staff and vitalizing the blood stream of both the sciences and the arts. It is to be noted that a large number of candidates for the doctorate in psychology came up through this channel without any intention of specializing in speech, merely utilizing acoustic and related equipments and movements in the laboratory as an avenue for psychological research. The continued offering for this group in physics, anatomy, physiology, education, and child welfare gave a powerful and sound impetus to the work in speech. The division of labor enabled Professor Mabie to throw all his energies into dramatic arts, building up the theater, in equipment and staff, to a degree which has given it outstanding national recognition.

The department of speech is now one of the largest departments in the University and falls naturally into four divisions: namely, dramatic art, public speaking, the science of artistic speech, and speech pathology.

Speech pathology is, of course, a branch of clinical psychology which can be best administered through the co-operation of psychiatry, psychology and education; yet there is a gradual transition from speech inferiority to speech superiority and therefore reason to keep close association between the clinic and the experimental laboratories. Likewise, research in artistic speech is effectively administered through the psychological laboratory and, from the technical point of view, is more closely related to psychology than to speech.

From the administrative point of view, I have worked aggressively for the breaking down of departmental fences and the establishment of working relations with related departments in the direction of rapidly developing liberal units, such as the school of fine arts and the school of letters. This policy has been facilitated in the University because the budgets come from the same source, and it is merely a problem of administration to determine from time to time where a particular unit can be best administered.

I am free to admit that success in the development of this bold plan hinged largely upon the fact that I had the interests and qualifications for the approach to speech from the laboratory side and, as dean of the graduate college, had considerable influence in determining policies

for organization and development in all new fields of research. But it must be remembered that the success of the movement depended upon the farsighted and enthusiastic support given by the head of the department, the dean of the college of liberal arts, and the president.

This account of the development in speech is given as concretely as possible to illustrate the plan and significance of this new concept of the doctorate, because that was the feature which proved to be the key to the rapid development of research for graduate work in formative fields. It drew to the University large numbers of selected and advanced graduate and post-doctorate students who carried the brunt of the burden of research as apprentices. It attracted the attention of large foundations and national associations which greatly increased the funds available for these developments.

THE THEATER

The graduate college provision for the acceptance of doctoral dissertations in the field of creative writing as described in Chapter IX was adopted in 1925 and has had much to do with the development of the department of speech. It has proved a happy companion-piece to the new provision for the doctorate just described. On this policy, one or more plays may be submitted for either the master's thesis or the doctoral dissertation providing they are supplemented by a formal critique or other evidence of broad scholarly background in the field. Supplementing the traditional historical treatments and the new approaches in the psychological laboratory, this type of dissertation has proved successful in that it has led to the development of facilities for creative scholarship of a high order and has accordingly drawn to the University superior talent.

In association with this theater, the University has done notable pioneer work in reducing play writing to a laboratory procedure. Instead of having plays written in the department of English as is conventional in most universities, that activity has become a comparatively complex unit of operations in which the writer first masters the appropriate background historically and scientifically and goes through a series of apprenticeships in writing and acting. Then follow three distinct stages in the development: (1) spontaneous writing; (2) laboratory analysis and criticism; and (3) production under the candidate's direction. To illustrate our conception of a writing laboratory, let me say a word about each of these stages.

A candidate, who at this stage of his graduate work chooses the

line of creative writing, must by this time have found himself possessing natural talent, a deep urge for the profession, and an adequate background for entering upon this, the highest stage of dramatic training. A play cannot be written according to rules; it must be written in the artistic mood which must find its outlet largely in the passionate rather than in the critical attitude. Like the composer in music, the playwright must strike when the creative mood comes upon him, undisturbed, in the artistic attitude.

The first thing is to inject vibrant life into the plot and its movements through unhampered imagination. The critical justification and adjustment of these is a secondary stage. Typically, the situation is one in which the writer projects himself in the artistic mood into the total situation of the stage. He may produce the entire play or reproduce the whole or parts of it in his imagination before a word has been written. The necessity of writing tends to take life-like action out of the picture. These imaginary creative productions may be repeated a number of times until he has a collection representing different choices and outlets and improvements in each successive trial which can be committed to writing. The central interest is in spontaneity and dramatic license. The author must show that he has something to give to the world and the gift to present it in a realistic and emotional form.

With that draft or series of drafts, he comes to the writing laboratory and submits the material to a socialized group under the direction of specialists for critical judgment — in regard to its artistic value as a whole and its adequacy in full detail. If the general plan of the production is approved as artistically effective, it is submitted to item analysis, well developed in psychology for the selection, distribution, weighting, and balancing of items and techniques, checking against historical, theoretical, and fractional considerations. The relative value of each item being thus revealed, experiments may be conducted to consider rejections, possible alternatives or refinements in the actual dramatic tryout in relation to an integrated situation. Here the laboratory technicians apply principles of acoustics, lighting, scenery design, and emotional appeal. It is gratifying to see how adequately the University theater laboratory can simulate and parallel the best scientific laboratories in dealing with hypothesis, invention, and interpretation.

All the parts having been fitted together, the play is cast for an experimental group of critical observers. Here it is repeated and

modified, and alternative forms are evaluated until the play is judged to have reached its final form in regard to content and every mechanical detail for stage production. Ordinarily the candidate for the doctorate produces a number of plays from which he can present one as his doctoral dissertation.

The third stage corresponds to the doctoral examination. The conventional doctoral examination, oral and written, is not eliminated; but the actual production with the author back stage as director becomes a test of fitness for the doctorate on a most exacting scale. Appeal is not only to the committee but to the actual theater audience. It is not merely a test of knowledge but must represent proficiency in artistic feeling, literary skill, and critical judgment. The plays chosen for experimental production may have a run of four or five nights to a full house.

The experimental theater enables the writer to familiarize himself with all the techniques of costuming, lighting, types of musical complement, auditorium acoustics, and types of carrying power of voices. He can avoid pitfalls into which the armchair writer often falls, as well as introduce new elements of vigor and novelty made possible by co-operation with the technicians in the experimental theater. Indeed, in the theater as a writing laboratory, we have one of the most clean-cut and vigorous demonstrations of the possibility and necessity of a scientific approach to an art.

The new scientific attitude radiating from the theater is felt in other fields of speech; as in oratory, debate, and the art of teaching speech and speech correction. It invigorates historical writing, develops broadened personalities, and takes a student's mind away from oratorical traditionalism, the tricks of debate, or predigested pellets in the art of teaching.

PHONETICS

Before the laboratory approach was adopted, training in phonetics was of the old-fashioned order of textbook recitations. When laboratory-trained Metfessel took over this subject in the speech department, he developed an introductory laboratory course which was required of all speech majors. This had a two-fold effect in that it injected the scientific point of view into the minds of all the students in the department. As a result a substantial interest in specialization leading toward research in the graduate work was stimulated. By the end of the first year, students had an adequate basis for selecting one

of the various routes; such as, dramatic art, public speaking, the science of art, or speech pathology.

In order to reserve the facilities of the psychological laboratory for research purposes, the department of speech set up a special teaching laboratory. This experimental approach for all students in the basic course became a foundation for work in the theater laboratory, but it also transferred in principle to non-laboratory subjects such as debating and oratory. In recent years Professor Fairbanks has given great distinction to this course in phonetics by directing and publishing research on specific problems pertaining to the content of that course, by carrying responsibility for phonetic features in the theater, by developing individual voices, and by directing research in this field.

ACOUSTICS

The science of acoustics has risen phenomenally due to the extraordinary new inventions and discoveries in the field of sound. In this the Iowa laboratory has had a proportionately large share in the rapid expansion of research. Speech and psychology have worked hand in hand with but little emphasis upon departmental sponsorship or channels for publication. As we review these developments in the psychology of music and the psychology of speech, it is revealed that the success that these subjects have had must be attributed largely to the fundamental policy of centering research upon basic problems in acoustics.

For thirty years the central interest in the psychological laboratory lay along the line of acoustics; laboratory equipment, subjects for investigation, and research personnel at first strongly represented this interest, with the psychology of music as the objective. This soon demanded concentration of work upon basic approaches to the science of acoustics, and speech and psychology joined hands effectively. In this development, Lewis, Travis, Johnson, Tiffin, Reger, Fairbanks, and Cowan have had leading roles.

It is now realized in the theater laboratory as well as in other activities of speech that every aspect of such problems as sound treatment of rooms, the evaluation of elements of carrying power of the voice, phonetic problems, and the selection and training of talent can be approached experimentally. The general science of acoustics already offers a respectable body of scientific information and techniques of treatment which daily increases and extends the mastery of the art of vocal utterance.

LINGUISTICS

The general field of linguistics as sponsored by separate and joint historical approaches from many different languages has for a long time laid claims to recognition for scientific dignity and validity. A formidable body of so-called facts and principles, mostly based upon authority, has furnished much of the background for the activities of learned societies.

But linguistics has come to a new departure which quite parallels armchair psychology in philosophy. The utterances of famous authorities are being questioned, and the position is being taken that the whole body of rich and highly organized theory must be taken into the laboratory to be challenged — to be verified or revised or discarded in accordance with laboratory findings accurately defined for measurement and verification.

This movement began a half a century ago through the introduction of objective techniques of recording, especially of primitive and remote languages. But it did not make much headway until it began to center on fundamental problems of phonetics, acoustics, and psychology. However, chairs in linguistics are still rarely occupied by men who have had the advantage of laboratory training or have the ability to take the experimental point of view first hand.

In Iowa we early recognized the great advantage of approaching the subject from the point of view of the underlying sciences rather than from an immediate practical solution or armchair speculation. Professor Cowan and his associates are among the pioneers sponsoring this basic laboratory approach which gives linguistic science the distinction of being an experimental science in itself.

THE TRAINING OF TEACHERS OF SPEECH

In educational activities, the traditional teachers and pupils have been eye-minded; this tendency has been strengthened by the development of reading, of pictorial illustrations, and of moving pictures. In the last two decades there has been a sudden turn and the world is rapidly becoming ear-minded. We are forming the habit of hearing our morning news, hearing the moving pictures, doing business by telephone, recognizing national and international figures by their voices, interpreting voice as a significant exhibition of character. In other words, situations which formerly came to us mainly through the eye may now come through the ear. At any rate, the ear supplements

the eye. This has introduced radical changes in our education from the preschool to the university by giving ear training and voice training recognition with the three R's in the elementary schools, and these interests are continued with expanding functions in the secondary schools and higher and specialized education. We now teach "oral" English.

Never has there been such a critical attitude toward quality of voice in speech. Never has the value of the power of beautiful speech been so highly appraised. The transition comes hard on the mother in the home, the teacher in the grades, and the musician who has an unbearable speaking voice, who have been ignorant of the significance of good speech and negligent in their attitude toward the power of beautiful speech for the efficient and attractive personality.

Now there is suddenly coming a demand for speech teachers at all levels, and this is pressing hard upon institutions like our own department of speech. It requires diversified training in speech proper and the development of pedagogical techniques. We have to pave the way for a new vocation in the science and art of voice. The city schools now demand special speech clinics, coaches in debating and oratory, and directors of dramatic work. Articulation is featured in musical education. A few years ago no preparation for situations of that sort had been offered, but now there is a special demand for extensive experimentation in speech and educational psychology in the development of personnel for this new field of activities. The extraordinary progress in teacher-training in this field in the last fifteen years was made possible by basic advances in psychology, acoustics, phonetics, and the vocal arts.

So it develops that teacher-training in this field which is making valuable contributions to the art of teaching in general, has its foundations in the speech clinic and the laboratory for the art of speech.

THE PRESCHOOL

It is generally recognized that the basic characteristics of a child's voice in speech-personality are developed very early in life and are relatively set by the age of five. Recognition of this fact in the Iowa Child Welfare Research Station and its preschool has led to extensive investigation of speech problems at that age setting up model activities for very early training in the appreciation and mastery of beautiful and effective speech. The speech interests in the University are therefore very greatly indebted to these investigators and preschool

teachers for their extensive and effective contributions to this field. On the other hand, the workers in the research station draw heavily upon contributions from the department of speech. Here, as in many other cases, two departments are enhancing their progress by a generous co-operative policy of give-and-take.

RADIO

The radio laboratory is on the top rung of the ladder of discovery, invention, and training in the art of speech. The good radio voice now leads to a pleasant and profitable occupation. For those who wish to concentrate either in the science or the art of radio or both, substantial progress has been made in the art of theoretical and practical training with laboratory experience and apprenticeship. The radio in turn becomes a great speech educator.

This laboratory is not in the possession of one department but draws freely from many sources for the development of the art of writing radio script, the engineering maintenance of a radio station, and the art of selecting and training talented voices for radio. The psychological laboratory does the recording for radio music and speech. There is a surprising demand on the part of teachers, even full professors, for the "lifting" of their radio voices. It is evident that a great deal of teaching, lecturing, and numerous other services can be done more effectively through a radio station having state or national coverage than through the customary speech. Many of the traditional types of teachers and lecturers are going to lose their positions because their places can be taken by talking moving pictures made with the best facilities for illustrating and conveying personal warmth and lifelikeness through combined eye and ear presentations by the most competent speakers in action. The large cities are now installing central radio systems and supplying films through which a single teacher can reach every schoolroom in the city where appropriate schedules of hours are arranged. Standardized tests and measurements are conducted through such a system; our measures of musical talents, for example, are now given in certain cities in this manner. A large part of the function of the room teacher is coming to be that of a supervisor to press the button.

Without a strong department of speech, the present functioning of WSUI as an educational and research institution would hardly have been possible. So, for origins, we go back once more to taproots in the psychological laboratory.

THE LINE OF PROGRESS

In this brief sketch I have attempted to show how a scientific approach to problems of speech arose and radiated and how diversified fields for research, adequate avenues for publication, and corresponding broadening of curriculum requirements to make the work attractive have come more or less directly out of the technical developments from the psychological laboratory. For the sound and rapid development of these diversified activities, credit is not easily distributed; no one is entitled to personal aggrandizement through such credit. Each man in a group along the line makes his contribution as a part of his day's work. We note that the coming in of a new point of view or branch of the service is usually the outgrowth from a person endowed with natural talent for that particular aspect of the work; that no one such leader can accomplish much single-handed; that the best progress is made through wise overhead planning and encouragement in his direction of research; that any effort to distribute credit for progress must reach out to sources of financial support, administrative fostering by presidents, deans, and directors who have the vision and power of initiative for launching projects and a sympathetic cooperative spirit not only with the various departments in the university but with national and state agencies and associations; and finally, that features originating in one specific department are rapidly taken over by special organizations or under different names by other departments as soon as their practical utility is demonstrated.

Chapter VII

CLINICAL PSYCHOLOGY AND PSYCHIATRY

BEFORE THE PSYCHOPATHIC HOSPITAL

At the beginning of this century there was no psychiatrist in Iowa. The doctors had scarcely heard of the term "psychiatry," and "psychopathology" was to many a new-fangled fad with which they would have nothing to do, although dealing constantly with psychopathic patients. The heads of the insane asylums were primarily business managers; their institutions were primarily for detention and safekeeping. There was one small private sanitarium in Des Moines operated by Dr. Hill. In the medical college, mental disease, mental health, and neuropathology had no place in the curriculum. The only spokesman for the mentally ill was Dr. Witte of the hospital at Clarinda, who annually gave six lectures on hypnotism to the medical students. These were entertaining but not illuminating for the future practitioners. Thus, the physicians of the state went out with no training in the nature of mental diseases or the treatment thereof.

The term "mental hygiene" had not come into general use nor had preventive medicine gained any distinctive recognition. The public school systems took no cognizance of mental health programs, and indeed, throughout the nation as a whole, there was little if any formal training for the discovery, prevention, and treatment of mental diseases. Yet in many parts of the state the prevalence of insanity was grave. Social amelioration in the interest of mental health had not made any headway, either in the University or in local communities. In general, it can be said that the medical profession, the academic faculty of the University, the public school administrators, and the churches, which should have been the four leading forces in the development of a mental health program, remained relatively ignorant of the gravity, the responsibilities, and the possibilities of the situation.

To whom should the mentally ill go for advice or treatment? The good family doctor frequently used common sense sympathetically just as he did in dealing with financial problems of his patients. For

this, many kind words could be said. Psychology was in the inceptive stage. I was the only professional psychologist with special training in the state. About 1910 we established the psychological clinic patterned after the Pennsylvania Clinic under Witmer. This became the second psychological clinic in an American university.

At that time, the term "clinic" was forbidding to children and parents as was the term "asylum," and yet a considerable variety and number of cases were handled there, showing to an alarming degree the need of clinical treatment. For a number of years this clinic was conducted by Dr. Sylvester, who had been trained here and under Witmer in Pennsylvania and was primarily interested in the problems of the feeble-minded. "Abnormal" psychology was coming to the front throughout the country, and for a number of years I offered courses in that subject. Cases came to us frequently as "interesting" and "curious" examples of mental behavior. We were then primarily interested in alternating personalities, automatism, and other mysterious problems of the subconscious which had arisen out of the British investigations in psychical research.

The dean of the medical college asked me to give lectures on psychology, but I refused on the ground that it would not answer the needs of the medical education. On the other hand, I pointed out the importance of an introduction to general psychology as a requirement for premedical students, and this was early adopted. Patrick took active interest in many problem cases. For several years I gave lectures on mental diseases in the department of psychology, based largely on Kraeplin, in whose psychological approaches I was greatly interested, as he had come out of Wundt's laboratory to lay foundations for a scientific approach to psychiatry. But this was all book learning. However, this innovation in American psychology was recognized; it was significant that I was invited to be a guest of Clark University at the invitation of G. Stanley Hall for a week's series of lectures and conferences by Freud, Jung, and E. E. Jones.

Owing to the absence of psychiatrists in Iowa and the barren point of view of the regular physicians on issues pertaining to mental diseases, together with the absence of any organized effort on the part of the medical college, I naturally took an active hand in the various efforts to create an interest in this issue throughout the state preparatory to the demand for legislation. In this I had a double purpose: first, the general interest in setting up an experimental hospital at the University as a clearing-house for mental patients; and second, the

integration of our psychological clinic with the out-patient clinic for children.

President MacLean was keenly aware of the needs in the field of mental pathology. After a number of conferences with the medical faculty and discussion in the board of education, he appointed a local committee consisting of himself, Professor Bolton, Dean Guthrie, Dr. Van Epps, and myself as chairman, to consider ways and means to provide for the treatment of the mentally ill in Iowa.*

We first took up the matter in a number of conferences with Mr. Schoentgen, who was then the most progressive and active leader in the board of education. On his recommendation, the Governor of Iowa authorized me to make a tour throughout the country to study and make a report on current tendencies in the treatment of the menally ill, both children and adults. On the basis of these findings, the local committee formulated the initial report.** We proposed the name "The Iowa Psychopathic Institute" and outlined its purposes, location, buildings and facilities, and plan of organization.

To this formulation, Mr. Schoentgen made very significant contributions. He immediately became enthusiastic about the project as a whole and played an important role in its development and promotion within the state board of education and in the legislature. A committee of the board was set up with Schoentgen as chairman and Brenton and Foster as members, ably assisted by Dr. Bannister. The original plan provided that the institute should be under the joint control of the state board of education and the state board of control. Accordingly, conferences between those two boards were held under the leadership of Mr. Schoentgen and while the report as a whole was approved in principle, both boards favored independent organization rather than joint control.

At this stage, President MacLean formulated the reports of the local committee and the Schoentgen committee in a recommendation to the state board of education and that body formulated and sponsored its recommendations to the governor and the legislature. At

* Dean Guthrie was nonresident dean and was sympathetic but took no active part. Dr. Van Epps represented neuropathology, and Professor Bolton, education; both sympathetic but relatively inactive. President MacLean gave most hearty support to the project, but his influence with the board at that time was not strong.

** One of the most significant by-products of this report was my formulation of findings in the study of the situation at Vineland, which has since then been the nuclear idea in my educational philosophy: namely, that it is the function of the institution to keep each person busy at his highest natural level of successful achievement in order that he may be happy, useful, and good. This idea permeates all my writings on studies in personnel, institutions, and educational organization.

this time as chairman of the finance committee of the state board of education, Mr. W. R. Boyd was instrumental in promoting this measure. The bill was first presented in 1917 but did not meet with sufficient response and was therefore withdrawn. In 1919 favorable sentiment had been developed, and the bill providing for the establishment of the Psychopathic Hospital at Iowa City was passed forty-three to nine in the Senate and seventy-eight to thirteen in the House.

From this stage on, the history of the project is well documented on the basis of legislative action, the organization of services for the state, and contributions toward the training of psychiatrists and other workers in mental hygiene. Through the establishment of the Psychopathic Hospital to supplement the work of the medical college, Iowa became one of half a dozen pioneers in this field and has maintained distinctive leadership for that type of institution under its two distinguished directors, Dr. Orton and Dr. Woods.

I have jotted down these reminiscent characterizations and incidents to reveal something of the gap between the barren situation at the beginning of the century and the status initiated by the establishment of the hospital two decades later. The phenomenal rise from the primitive level of institutions and procedures to a position of leadership in the adoption of the most advanced medical practices of the day represents an epochal development of medical science and art in a progressive midwestern state and was quite in harmony with similar radical changes taking place throughout the country.

CONFERENCE ON THE RELATIONS OF PSYCHOLOGY TO PSYCHIATRY

Twenty years ago organized psychology and psychiatry were at swords' points, and the time had come for a truce in this warfare. At that time both professions had discovered a new territory and found themselves upon an exciting frontier; both had rushed in to secure squatter claims and were in no mood for friendly relations. In this territory loomed the problem of dealing with all types of mental disorders in their inceptive stages in very large numbers in education and society; but neither psychologists nor psychiatrists had penetrated the region enough to realize the full nature and magnitude of the discovery. It was at this time that the relations between the Psychopathic Hospital and the department of psychology at Iowa were being clarified.

In my co-operation with Dr. Orton and in conference with the president, representatives of the medical profession, and psychologists and

psychiatrists throughout the country, I had become keenly aware of the problems which lay at the bottom of this warfare. In 1919-1920 I was vice-chairman of the division of anthropology and psychology in the National Research Council and represented psychology. Professor Wissler was chairman and represented anthropology. It was a tradition in the Council that the chairmanship should alternate between psychology and anthropology and that the vice-chairman of one year would be the logical appointee for the chairmanship the following year. As vice-chairman I spent a good deal of time in Washington arranging plans for the coming year.

We conferred with the division of medicine headed by Dr. McCoy and decided to do something which would help clear up this situation. As a result we secured funds from a foundation for holding a national conference devoted to this problem. The conference was called for April 30, 1920 and continued for three days with evening sessions.

The membership consisted of the representatives of the learned societies in this field. Dr. Walter E. Fernald for the American Association for the Study of the Feeble-Minded, Dr. H. W. Mitchell for the American Medico-Psychological Association, Dr. Hugh T. Patrick for the American Neurological Association, Dr. H. L. Hollingsworth and Dr. F. L. Wells for the American Psychological Association, Dr. Francis N. Maxfield for the Clinical Section of the American Psychological Association, Dr. C. Macfie Campbell for the American Psychopathological Association, Dr. Thomas W. Salmon for the National Committee for Mental Hygiene, Dr. William A. White and Dr. R. M. Yerkes for the National Research Council, Dr. G. W. McCoy for the Division of Medical Sciences of the National Research Council, Dr. David Mitchell for the New York State Association of Consulting Psychologists, and Dr. S. C. Garrison for the Southern Society for Psychology, together with Dr. Clark Wissler as chairman, made up the membership of the conference.

This was a formidable body, thoroughly representative and anxious to accomplish something. The stenographic report of the entire conference was issued in mimeographed form but in limited edition since it contained a great deal of information which might have been regarded as confidential. That report is of such great historical significance that it should be printed now and put into general circulation in libraries and in professional groups. As seen in the historical events of the preceding twenty years and in the succeeding twenty years, it becomes evident that the conference was an epochal event.

As one of those intimately associated with the organization of this program, I wish to present some reminiscences and indicate something of the character of the warfare, the outcome of the truce, and its significance.

There was in the situation every element of an intensive war. Both sides were contesting for "living space." Each considered the other an intruder. Neither had developed an adequate administrative conception of the situation. Each was inadequately staffed for dealing with the situation. Very few, if any, had any real conception of the magnitude and the nature of the responsibilities involved. Both factions were more or less frustrated, not only with opposing factions but within their own groups.

Look at psychology. The war had put all but a handful of the leading psychological laboratories out of commission temporarily; and as a result of the success of the army tests, there was a grand rush into the field of paper and pencil testing as a substitute for laboratory and clinical research. New schools of psychology were becoming sufficiently conspicuous to cause unrest and distrust. There was no adequate training available for clinical psychologists. The public was imposed upon by charlatans who posed under the name of psychology in their frauds of diagnosis, guidance, and treatment. The clinical section of the American Psychological Association had just been formed and was beginning to analyze the situation. In this group there were some very able psychologists but very few technically trained clinicians.

Efforts were being made to define clinical psychology and to secure legislation to protect that profession. A very delicate issue was the question of the right to charge fees for practice and that fell back on the issue of medical certification. Presidents and heads of departments of psychology in leading universities were not aware of the situation in any effective way. But psychologists from all sources were confronted with cases in large numbers and endless variety, clamoring for help. And what should they do? The leaders admitted their inadequate training, their absence of adequate certification, and the strong opposition from the medical profession. In short, it now seems strange that psychology as a science got through that period without losing all its standing among the older sciences.

Psychologists had not yet discarded the traditional bifurcation between mind and body or been influenced by the various contributions made by divergent schools of psychology or convergent trends in

these schools. Supporting biological, social, and educational sciences had not yet made significant contributions. The practical work before the psychologists was in very crude stages and furnished but little background and experience. The psychologists' attitude would have been radically different if they could have approached the situation from the theoretical point of view which is now becoming dominant in psychology.

As ex-president of the American Psychological Association, as organizer of the psychological clinic in Iowa, and as associate with Dr. Orton in building up a joint program, I was perhaps as fully aware of the shortcomings of psychology and the difficulty of the situation as any psychologist could be at that time and was therefore in a conciliatory mood willing to apologize for all our shortcomings and ready to consider sympathetically all the shortcomings of the opposition. On the other hand, as one who had been in on the ground floor, I was fully aware that we were just entering upon a formative period attempting to blaze new trails in the absence of established traditions or precedent and should therefore be dealt with kindly by the opposition.

But let us look at the medical situation. At that time the medical profession was not aware of the true extent of mental disorders. The mental hygiene movement headed by Clifford Beers had not yet penetrated deeply into the medical profession. Indeed, the majority of practicing physicians avoided that aspect as something which was not their business. The profession of psychiatry was not recognized in its own name except in a hit-and-miss fashion. Those who went by the name of *psychiatrist* had come out of the various European schools of medicine which had come to the front and were carrying the European schisms over into the new soil. There was no general agreement in regard to diagnosis and treatment. There was no medical school that furnished adequate training for psychiatry. Indeed, it was repeatedly expressed by medical men who were present at the conference that there should not be any special provision for training a psychiatrist in a medical school.

Then a future psychiatrist took his four years of medicine as rigidly prescribed; and at some stage during his internship, he began to specialize. One centered upon otology, another upon internal medicine, another upon gynecology, another, orthopedics. They all had substantial training in the art of dealing with physical disorders. The future psychiatrist was expected to follow this pattern and get his

apprenticeship in any way that he could. Unfortunately, this apprenticeship was of the worst possible kind as the students were interned as assistants in the hospitals for the insane which were usually operated by successful business men without any competence in medicine and with training and experience only as detention officers in a big institution. These men in the hospitals were not to be blamed because they were men of their day; they had not seen the coming of a new day or anticipated the then-dawning mental hygiene movement.

One of the glaring defects was the inadequate supply of psychiatrists. We now recognize that there are as many mental disorders as physical disorders and that the two are generally interwoven; but at that time — to make a rough stab — there was less than one so-called psychiatrist to every 500 registered practicing physicians. The American people did not complain about this because, like many of the practicing physicians, they had no conception of the seriousness of the problem. Yet this handful of newcomers set up a scheme for complete command of this newly discovered territory for which they were not prepared. The whole situation seemed preposterous to the psychologists. At that time no medical courses had made adequate provision for the study of genetics, mental development, social aspects of crime, or personality, as a whole.

But in this conference there were a few representatives who had a large and true vision of the imminent future in this situation. Among these were Salmon and Fernald on the medical side and Yerkes and Mitchel and Hollingsworth on the psychological side. The entire group was influenced by the movement originated in Johns Hopkins under Dr. Meyer. The underlying idea was that in treating disease, both mental and physical, it is necessary to know and understand the history of the patient, his environment, and his personal conflicts. No organized training for that had been offered in this country. Therefore, the discussion turned to the most significant issue: namely, what training for this should be offered, where, and by whom? Since it involved several sciences, social and biological, there was profitable discussion about what name should be given to this type of training. This discussion may really be counted as the psychological-medical birthday of the term "psychobiology" and the beginning of the movement under that caption.

A fundamental idea was that for both curative and preventive medicine it is essential that the total personality and environment of the patient be taken into account in so far as possible and that he be re-

garded as a psychophysical organism. The notion was expressed that one person or a small group of persons should be regarded as the dispensers of this type of information. It soon developed that what was needed was the decentralization of authority and a democratic organization of underlying and co-operating sciences.

As in any international warfare, the determination of the victor is to make the vanquished a vassal. This tendency has been a stumbling block in the process of all evolution. An intimate acquaintance with the history of these projects from the beginning of this century clearly reveals the reasons for all the shortcomings on both sides. All contestants had alibis and as these shortcomings became aggravated in the fighting situation they were dangerous. In each side of this group there were a few typical men who had effective vision of the aims and objectives of this war in a possible new world of mental hygiene. But the fighting spirit was carried into the conference so that within the limits of gentlemanly association, spades were called spades and courage with words took the place of courage with professional contests in the fields of practice. Woodworth summed up the situation in these words:

> The offensive behavior of which psychologists are guilty consists of a crowding in upon the field of the psychiatrist, in aping the medical profession, and treading on the sensitive medical toes. The offense of the psychiatrist consists in staking out, on paper, an exclusive claim to a large unoccupied domain, and insisting that the psychologist shall only work there in subordination to himself.

The seriousness of the situation was revealed by the first issue raised: namely, the definition of terms, such as psychiatry, clinical psychology, diagnosis, treatment, fee, chief and assistant, mental disease, personality, neurosis, clinic, and measurement. Another issue was the attempt to define the newly discovered territory. The problem of the right to practice brought out fundamental facts which have greatly helped in stabilizing the ship since that day. To whom should the case come first — the psychologist who is likely to be the first one to see it, or the physician? If various agencies co-operate in the attempt to diagnose the situation, whose business is it to make the synthesis? Should the directors of institutions for mental cases be required to have medical licenses? Is either side competent to deal effectively with the demands of social and educational situations?

On the problem of education for psychiatry, the medical group did not budge significantly from its original stand; namely, that it was a

unit in the field of medicine, and to enter this field which is merely one of specialization, one must begin at the bottom. It gave no recognition to the need of training in technical psychology or psychobiology as we know it today.

The conference was a battle of the experts in polite form. One must read the word-for-word stenographic report to realize the great significance and vitality of these discussions. Efforts were made to pass resolutions, but these made no headway except on the resolution to thank the chairman for a masterly conduct of his office and to express appreciation for the privilege of sharing in the conference as representatives of the leading national organizations. But each participant gave assurance that he would carry the message home to his constituency.

Certain general features, however, became clear. First, there is an overlapping area which cannot be sharply defined either in theory or in practice. The nature of this area is subject to constant change in the rapid social, educational, and medical evolution centering around problems of mental hygiene. To understand the abnormal personality, one must have a comparable understanding of the normal. This was a long stride in the movement to launch psychobiology and became a serious challenge to both sides.

Second, there came a determined effort to use every means available for improvement in the qualifications for practice on each side.

Third, to deal competently with the situation, the provision was made that persons should be trained both as psychologists and as psychiatrists, the ideal being a combination of the two. Inquiry revealed that at that time there were only half a dozen men who were so trained and two of these have not been heard of since!

Ultimately, primary responsibility for this area should rest with physicians competent to deal with the situation as a whole from the administrative point of view. The now current and effective school clinics and social centers in the large cities had not yet made their appearance, but it was suggested that coming organizations within this field be made up of a staff representing medicine, psychology, and social service.

In the midst of this mêlée, I had the pleasure of reporting actual accomplishment in the way of a comprehensive and constructive policy then actually operating in Iowa. I was able to say that we had reached a full and frank recognition of the existence of a borderland between psychiatry and psychology and had united on a thoroughly sympathetic

and co-operative program of research and service; that this is centered in the new experimental Psychopathic Hospital with sixty beds and an out-patient service; that the psychological clinic has been transferred to the hospital and made a part of the out-patient service; that all this work is under the general direction of the head of the Psychopathic Hospital; that large responsibilities are placed upon the department of psychology for research and the extension of services outside of the clinic; that the function of the psychologist in the hospital proper is to have charge of psychometrics and introduce psychological technique in the conduct of research; that a specialized branch of the psychological laboratory is being built in the hospital but access to the central psychological laboratory is continued; that the various services in the medical college are available for mental patients; that graduate students majoring in clinical psychology are allowed generous admission to courses and the clinical facilities of the hospital; that it is a policy of this organization to train specialists for this field by the utilization of essential courses in the medical college and in the pure and applied aspects of psychology, and through facilities for internships and research services in the hospital and in the field; that it is our policy to utilize techniques in social service and training for this; that it is our policy to develop services in social centers and in the state educational and other institutions.

All of this forecasts the development of a comprehensive mental hygiene program in the state. It was at once recognized that this Iowa program was without precedent in any other institution and that it was indicative of a happy beginning of a solution of the conflict between psychiatry and psychology.

Looking back upon the development throughout the country and in Iowa in particular since the time of this conference, I feel that the work of this conference was the pioneer work at this frontier which opened the way to progress and expansion in mental hygiene. As intimated, the Iowa solution had been mapped out and tentatively organized before the meeting of this conference, but the lessons learned there have been constantly rehearsed since that time and progressively put into practice.

The symposium on mental health under the auspices of the American Association for the Advancement of Science published in 1939 [32] gives a most comprehensive picture of the situation today. It reveals

[32] Publication of the American Association for the Advancement of Science. No. 9. [Edited] by Forest Ray Moulton and Paul O. Komora. Lancaster, Pa.: The Science Press, 1939.

an extraordinary growth but this volume still reveals controversy and shortcomings as in the conference of 1921 though much chastened.

SPEECH PATHOLOGY

A particular incident gave a significant turn to events at the beginning of co-operation between psychiatry and psychology. The case of a child who had serious reading and speech disability came to the attention of Dr. Orton, and he tried what seemed to be a fundamental theory for the interpretation and treatment of such cases. At that time problems of reading disability and speech pathology were in primitive stages. Dr. Orton thought it might be wise to secure as a psychologist a person who was well trained for the development of that unexplored field. A careful survey of the country showed no such person available. We therefore decided that psychiatry and psychology should undertake the training of a specialist for this field and accordingly selected the most promising senior, encouraging him to go into training for this position.

We selected Lee Edward Travis and planned a very comprehensive course of training in psychiatry and psychology for him, the main objective being preparation for specialization in this field. Travis had majored and found himself as an outstanding student in experimental psychology. Under the joint direction of the two departments he immediately began a series of experiments on the theory of stuttering and qualified in the customary historical and theoretical background required for the doctorate in psychology. His doctoral dissertation turned out to be a significant and basic contribution to this subject. During this period he became thoroughly acquainted with hospital routine, having enjoyed the privilege of sitting in at staff meetings and experimenting on selected patients. He was then awarded a National Research Council fellowship and assigned to the continuation of his researches in the local situation, where he now had a good start with the best facilities, and certain privileges for traveling abroad and acquainting himself with new movements in this field. This fellowship was renewed twice so that at the end of six years he had pursued a specific objective under the most favorable circumstances and had revealed his ability in the conduct of research within this field.

The local, as well as the out-of-state, appreciation of his work is testified to by the fact that at the completion of his third year of the post-doctorate, he was offered a full professorship at the University

of Michigan in the field for which he was trained with a salary of $7,000, which was at that time extraordinary for a man without any teaching experience. This was unusual for both Iowa and Michigan, but since we felt we could not afford to let him go in view of the service and equipment which had already been built up, Iowa had to meet this salary. This action has been amply justified by the resulting developments, and I think the case should go down in history as an example of a "tailor-made" research professor.

Even during the period of his training, a rather remarkable group of research students gathered around him and engaged in research in the general field of speech disabilities. Iowa became the mecca for students in this field. A few years ago a survey was made in which speech clinics established more or less after the Iowa pattern were classified into two groups. There were five institutions with well-established speech clinics of university rank, and about twenty clinics, most of which were headed in the same direction. It was found that the heads of four of the five well-established clinics were Iowa trained men, and that about two-thirds of those operating in the less developed clinics had been trained at Iowa.

Here is an example of the way in which the fields of psychiatry and pure and applied psychology of speech were enriched through cooperation. The literature which has sprung from the researches thus initiated is extensive and fruitful for theory and practice in speech pathology. From the beginning, emphasis has been upon fundamental research, thus carrying investigations into a variety of new fields of approach.

Throughout the country up to this time, stuttering had been treated mainly by men not recognized by the medical profession, and it had been sponsored by quacks and not by psychiatrists. There were scores of methods of treatment in vogue, each advertised as a nostrum. Dr. Orton had placed great emphasis upon the effect of transferring patients from a natural left-handedness to a practical right-handedness as a causal factor. Around this theory Travis organized a variety of experimental approaches, both theoretical and therapeutical as well as statistical, extending in two directions: electrophysiological studies into the laws of bilateral valence or inbalance, and the possibility of retraining stuttering patients by transferring them back to left-handedness. Out of these studies grew a number of new concepts; and while the experimental work was first centered largely in the effect of handedness, the clinic has attempted throughout to

criticize and validate all current theories, gradually building up a policy of treatment which will take into account many other varieties of causal relations and principles of treatment. Much of the work in the clinic has come out of intensive studies of case histories. It was soon recognized that speech disorders are but the overt manifestation of the presence of organic disorders or general personality maladjustments through heredity, environment and faulty education, which are largely of an emotional nature. As in all therapeutical work, each speech case presented a problem of its own, psychological, psychiatrical, social, or educational.

Stuttering graduate students were thrown into research projects for an experimental study of their own symptoms and progress under treatment. As a result, speech pathology developed in two fairly distinct lines of approach: namely, basic neurophysiology, and general theory and refinement of clinical routine in the handling of patients. In the latter, Dr. Wendell Johnson, who came to the clinic as a stutterer, has developed valuable leadership as the cases which come for treatment have gradually come under his direction with gratifying results.* Many similar cases have followed where a severe stutterer has made practical recovery and gone out as a specialist. By sending out clinically trained inceptive specialists in speech, especially into social centers and public school clinics, the services of this Iowa clinic have been vastly extended.

Patients have come from all parts of the country, but it has been the policy of the clinic to admit only those who are most valuable for clinical experimentation in progress. In view of the pressure for treatment, we suggested to the president that if he would provide a building which would accommodate about 200 speech patients coming mainly for professional treatment but at the same time engaging in collegiate or more elementary studies through our educational clinics, we could guarantee a full house, a large part of which would be a paying constituency. It is hoped that such a venture may be undertaken in the future strictly under university supervision; but to the present time the University has not seen its way clear to expand into this professional aspect of diagnosis and treatment.

In 1930 the research laboratory for speech moved into its present

* I am placing on file for persons especially interested in this feature, a memorandum prepared for this purpose by Johnson at my request, showing how from the original attack in terms of a specific theory there has developed a research program with the necessary clinical facilities bearing not only upon speech disorders but centering more particularly in the problem of personality disorders, and how, out of the techniques used in the study of speech, Iowa has acquired notable leadership.

quarters in East Hall, where extensive space was allotted for a branch of the general psychological clinic with special emphasis upon speech disorders. This speech division was under the joint control of the departments of speech, child welfare, and psychology. Since the psychological research work done in the Psychopathic Hospital had concentrated largely on speech cases, Dr. Woods felt the experimental equipment built under the direction of Travis should be set up in the new joint laboratory in East Hall. When this was done the facilities for work in electrophysiology — much of which was of a fundamental nature pertaining to speech — were greatly increased. The work in the clinic has expanded rapidly as a receiving center for routing patients to various hospital services and particularly for examination in the out-patient service wherever the need is indicated. Since general medical and psychiatric analysis and treatment have been provided for, the work in this branch is devoted primarily to re-education; and, with a well-established interest in speech correction, the bulk of the work centers around speech cases because of the extensive research and progress in that field.

It is interesting to note that in all these fields the thing which first attracted attention was the discovery of something wrong which might be set right, and work upon this soon led to a much more positive program of laying foundations for general research, as in phonetics, reading and personnel work. In view of this, it is not discouraging to find that although the original Orton theory is not given the prominence it had in the initial stages, the experimental work centering around it has served to clarify its implications and bearings in a way which will prove very helpful to clinical theory and practice.

The significance of concentration upon research rather than upon treatment and the utilization of well-established psychological techniques in clinical psychology on the initiative of the psychologists is very well documented at Iowa. If the same amount of money and energy had been devoted to the mere treatment of speech cases from the beginning, it is conceivable that the results might have been very barren.

The workers in this field have developed a broad and substantial insight into the bearings of speech disorders and have acquired skill in setting up research programs for the cultivation of beautiful and effective speech and the unification of researches in phonetics, acoustics, speech, physiology, child development and psychology proper. The story of the development of speech pathology in the University of

Iowa and the resulting expansion into various specific fields of intensive study in electrophysiology, acoustics, reading and personality adjustment, together with the numerous contributions which have come to pure psychology from these studies, are of such magnitude they deserve an extended account in the history of unfolding psychology and psychiatry in this country.

PSYCHOPATHIC HOSPITAL

As indicated in the preceding section, the development of the Psychopathic Hospital under the leadership of Dr. Orton was perhaps the most significant movement toward co-operation between psychiatry and psychology in any American state university at that time. For this reason, a brief outline of the plans of operation of the hospital may be apposite here.

The hospital was established by an independent charter from the state, primarily for the purpose of serving as a clearing-house for incipient mental cases. This guaranteed a constant turnover of patients who passed through it for diagnosis and temporary treatment thus insuring a sufficient number and full variety of clinical cases as a working unit for staff and students under the most favorable conditions for study and demonstration. Where permanent deterioration or necessity of care was indicated, transfer to one of the state institutions was made promptly; and thus facilities for more temporary cases were made available for immediate remedial treatment and general consultation. This encouraged patients to come for consultation or treatment earlier than they would ordinarily have come under regular state hospital organizations. It facilitated the development of preventive measures, as consultation for patients who were not of the type to be hospitalized became a prominent feature, especially in the out-patient division.

The hospital thus became a central research station in the state for the investigation of techniques in clinical therapy, neuropathology, physiology, psychology, and mental hygiene in general. Members of the staff were selected with reference to their qualifications for leadership in experimental work, not only for immediate practical purposes but more especially for a long-time program in the development of theory of mental disorders. In this it had working arrangements with the various departments of medical services in the general hospital and opened the way for large-scale co-operation with the various scientific departments in the University, together with the departments

which represented social, hygienic, and educational services. This utilization of university facilities was regarded as the principal reason for locating the hospital at the State University and making it an integral part thereof.

In this way it became an effective training institution. It first met a long-felt want for a segment in the undergraduate curriculum of medical students, giving all future physicians general orientation in the field of mental pathology and thus integrated this aspect of medicine with various branches of theory and practice in the medical school, devoted more particularly to physical theory and therapy. It provided facilities for extensive internship for graduate work in psychopathology, leading to education of specialists in the various branches of psychiatry. It entered upon a co-operative program for training clinical psychologists through instruction and research under the leadership of psychologists and psychiatrists with the full facilities of the hospital. It undertook the training of technicians in social service and medical re-education.

It inaugurated a mental hygiene program. In this it became the central institution for the state with responsibility for preventing the development of mental disorders by education and the establishment of various centers of medical, social, and educational services with special emphasis upon co-operative researches centering around this field of preventive medicine. It assumed responsibility for co-operation with the established state hospitals and other state institutions in the development of staffs and the introduction of progressive methods of treatment.

It became a clinical personnel unit for the University as a whole, thus assuming responsibility for the model operation of a psychiatric unit in a medical examination of all entering students and a service station for general consultation and treatment of all mental disorders in the student body.

It assumed administrative responsibilities for the psychological clinic in co-operation with the department of psychology and other agencies in the University dealing with the development of mental health and adjustment of children. The psychological clinic was housed in the out-patient ward.

It made the operations centering in the hospital a companion-piece to the Child Welfare Station in that it recognized the division of labor for researches on mental disorders, as distinguished from researches on the normal child, in an effective program of co-operation.

THE PSYCHOLOGICAL CLINIC

Purposes

The psychological clinic has had a rich and varied but somewhat amorphous series of shifts in scope, organization and growth. But from the first, certain purposes have been clearly recognized and maintained. The first problem we took up was that of analyzing feeble-mindedness, considering what could be done to improve conditions for the mentally defective in Iowa. It was the first time scientific thought was directed to that serious problem in the state. After that, scores of projects were taken up in order to keep apace with, or in front of, the procession of new developments which have since then been grouped together representing clinical psychology.

Our central interest has, however, lain in the conduct of specific researches in new fields recognized in the clinic. Thus our primary interest has not been in immediate treatment or services but rather in perfection of techniques, approaching the subject from the two points of view of laboratory technology and procedures in medical clinics.

This had led to the training of technicians and specialists in clinical psychology. We have been fully aware that from the point of view of returns for university services, training and sending out a competent clinical psychologist for a lifetime career in the subject is a far greater service than is the contribution coming from, or equivalent to, a doctoral dissertation or the treatment of a few patients who are subjects in the clinic.

Naturally in opening a new field, the goal has been to discover and validate practical solutions of the difficulties through clinical re-education and adjustment. Here the services which had their origin in the clinic have come to fruitage in gradually standardized educational and social services.

Recognizing the importance of discovering mental difficulties among the young, emphasis has been upon development of preventive measures at the expense of time for remedial treatment of established deficiencies. It was this principle that led to our breaking ground for the Child Welfare Station.

General Principles

In operating the clinic as a practical center of origins in clinical psychology, certain principles of administration and organization have given tone and character to the Iowa movement, among which the following are distinctive although often of purely administrative sig-

nificance in the office of the head of the department. First is the policy of allocating and integrating activities outside the department of psychology or the central clinic proper throughout various offices, departments, schools and colleges; such as, the office of the dean of men, the department of otology, the school of fine arts, and the college of education. This has tended to mask and outshadow, and often ignore, the central clinic; but the fact is that it has led to operations of a vastly larger scale than could have been maintained in the clinic proper. It has been like taking shrubs and trees from the university nursery, placing them effectively in the university landscape for flowering and fruitage.

Next to this first principle is what James called the "brass instrument" attitude. A great deal of clinical work undertaken in educational institutions has been close to the border of charlatanry. To combat this, the influence of the clinic in launching new services has always favored the introduction of rigorous laboratory techniques. Where instrumental measurements cannot be used, adherence to strictly scientific principles, even of a secondary order, has always been insisted upon. In this respect, influence from the central source has often been repressive, especially in discouraging efforts to count the uncountable.

Primary emphasis on cases has always been directed toward disabilities. It has been a constant struggle to avoid diversions from the immediate clinical objective of spreading into the vastly larger field of normal capacities and abilities. Thus in the clinical fields of music, speech and art, the first clinical objective has been to discover impediments or disabilities if they exist; and in the interest of specialization for research, to disassociate this procedure from the much larger job of analyzing the functioning of normal features as art principles.

Another principle which has done much to vitalize clinical movements in the University is the policy of not launching a new effort until it can be personalized. Some person must be found who is capable of taking initiative and assuming responsibility for the development of his particular area of clinical operations. On this principle, new movements have frequently been started by giving such responsibility to an advanced, preferably a post-doctorate, student who has thus laid foundations for a local service and entrance upon a specialized personal career. Our most notable example of this is the development of the reading clinic, which has come almost entirely through a number of advanced students in research within this field.

Stages of Development

The essence and permanent backbone of what we may call the psychological clinic lies in our adherence to the above purposes and principles of organization. The organization has gone through three distinctive stages. The first stage covers the first twenty years, in which progress was limited by absence of adequate personnel and resources of the University. The second stage begins with affiliation with the Psychopathic Hospital. This co-operation with psychiatry introduced a fundamentally new era in clinical psychology under the auspices of psychiatrists, with access to clinical facilities of the hospital. The third stage covers the gradual expansion into clinical developments centered in East Hall, through the operation of the joint speech-and-psychology clinic, concentration upon fundamental research, and development of a variety of researches which served as a sort of clearing-house for the out-patient service in the hospital and for various educational and social services.

PSYCHOMETRICS

In the original program of the hospital, two functions were assigned to the chief psychologist on the staff; first, injecting techniques of experimental psychology into research in training psychiatrists and psychologists; and second, rendering routine service to supervise what was then recognized as psychometrics in setting up case histories in the hospital. On the latter, the practice went through a significant change as we started with the policy of employing advanced students of clinical psychology as apprentices to do the psychometric work. It was soon found that the students put into this service were primarily interested in psychological research and were inclined to become impatient with the assignment to the then well-established routine Binet technique in the hospital. The psychological service therefore definitely split into two directions: first, the conduct of research on hospital patients, both admitted adults and cases handled through the out-patient service, especially for children; and second, the conduct of the psychometric service.

To facilitate this, the original policy of employing a student of psychology, as a research assistant primarily interested in research, to do psychometric work was abandoned, and the hospital established the practice of selecting its own psychometrists with the prospect of more or less permanent tenure. While the psychometrist has a seat at staff meetings, his job is specifically that of a technician. His salary was

therefore transferred from the budget of the graduate college to that of the hospital.

This change proved beneficial because it led to a wise distinction and selection of personnel for the two types of service. The interests of the department of psychology thereafter turned exclusively in the direction of the development of clinical researches and gave the psychologist a really functional seat and responsibility in the daily staff meetings of the hospital so that he, like the psychiatrist, accepted the ready-made psychometric report on each patient and joined with the psychiatrist in the interpretation of the case history and the evaluation of modes of treatment.

It was recognized that his service lay largely in the conduct of the psychological clinic, dealing with the receiving and, in co-operation with psychiatrists, with the routing and treatment of children.

The recognition of this place for the psychologist was a comparatively new idea in hospitals at that time, but it proved a distinctly forward step by opening the hospital constituency of patients to the psychologist and making it possible for the psychiatrist to refer the investigation of more or less purely scientific issues in research to him.

The facilities for training psychometrists in the University have become widely diversified and elaborate, especially through developments in the Child Welfare Station. It is recognized that there are now a wide range of techniques which must be mastered, that familiarity with measurement of the normal child is essential, and that a certain amount of psychiatric and social experience is demanded.

In setting up an extension of the clinic in East Hall, this became virtually a receiving unit in which the intake was analyzed by psychologists and assigned for remedial treatment through re-education in the clinic or referred to the various services in the hospitals. Therefore, when a child was sent from there to the psychiatric clinic, he had been selected as probably in need of distinctly psychiatric treatment.

THE READING CLINIC

A reading clinic has been gradually developed in the department of psychology and has had three objectives: first, conduct of research in reading disabilities as a technical unit in the personnel service for freshmen; second, conduct of the clinic furnishing remedial training in reading; and third, co-operation with activities in the college of education for clinical treatment of children with marked reading disabilities.

In co-operation with the college of education, the office of admissions, and the offices of the dean of men and the dean of women, a distinctive unit in the personnel service for the discovery and analysis of reading disabilities has been established. Every entering freshman is required to pass an examination in reading for the purpose of identifying students suffering from this disability in such a way as to materially handicap academic work. We now know that a considerable portion of the students are blocked in their studies by some form of reading disability. Not infrequently one finds among college freshmen cases of distinctly infantile types of reading. These disabilities may be of various kinds, both physical and mental, and may occur in varying degrees of seriousness, often being no more than bad habits in reading. The analyses are promptly reported to the administrative offices concerned, with specific recommendations for medical attention or clinical re-education.

The offices of the dean of men and the dean of women, acting upon these recommendations, order medical treatment or clinical re-education. Where the need of the latter is indicated, the student is registered for treatment in the clinic to be conducted long enough to remove the impediment or prove that it is not removable. In a large percentage of the cases, the treatment is successful and yields the needed relief; but where in serious cases the student does not respond to treatment due to either lack of effort or to the nature of the case, he is advised to leave college. In these analyses, inceptive mental disorders are sometimes discovered and indicate the need of general personality adjustment or psychiatric treatment.

Cases of marked reading deficiency in the elementary schools are referred to the clinic for analysis and remedial treatment. The instruction and the practical facilities of the clinic are utilized for training teachers of elementary reading. The elementary textbooks on reading and the practice of teaching reading in the schools are beginning to take account of the clinical point of view. This gives the teacher an insight into the nature of the defects from which poor readers suffer, and enables them to detect these defects early in life, where treatment of both constructive and corrective natures is more effective.

In the early stages, research centered around the studies of eye movements and in the refinement of techniques of diagnosis. The development of the eye camera did much to give a scientific turn to the study and treatment of defective reading. But naturally, the opera-

tion of such exactness of measurement led to the discovery of other equally important factors in the ability to read.

The main reason for continuing the clinic in the department of psychology lies partly in the fact that the procedures originated in this department, but more significantly in that the activities here center around research, the local services being a by-product.

THE IOWA INSTITUTE OF MENTAL HYGIENE

In 1929, general plans for the organization of the Iowa Institute of Mental Hygiene came to a head by its formal organization, representing a most important stage in progressive pioneering in psychiatry, psychology and education. The plan was unanimously adopted by the units involved and was approved by President Jessup. Upon the encouragement of a foundation, we immediately proceeded and made some progress in negotiating for personnel for which we had been assured support.

At that time the whole situation looked rosy, but just then the depression came. The foundation from which we had received encouragement was forced to rebudget its expenditures, and we had to await the hoped-for period of return to normalcy. In 1934, such a return seemed to be in sight and the new president, Gilmore, reviewing the docket on his desk, called for a statement of the present status of the project. I was authorized by the committee to report that the original plan was still appropriate and that as soon as the prospect for support from some foundation should reappear, we were ready to forge ahead. As everybody knows, normalcy has not yet returned. The project is therefore still on the president's docket with the supporters still hopeful and enthusiastic for the opportunity to proceed.

It was a pioneer venture, one in which Iowa was particularly well situated for leadership. That it was headed in the right direction is manifested by the fact that during the last decade many aspects of such a program have come into the foreground among the leading psychiatrists, and especially through federal and foundational encouragement of research in mental hygiene.

At the present time, 1941, these developments have all confirmed the wisdom of the proposed project. I therefore take the liberty of inserting the committee's reply to President Gilmore in 1934, with the hope that when the economic condition throughout the country and in this state can justify it, the original program may be put into operation, perhaps on a larger scale. In the meantime, notable progress has

been made in the University along the lines indicated for the institute, and we are today far better qualified to sponsor this program than we were a decade ago.

August 20, 1934

My dear President Gilmore:

On behalf of the board of the Iowa Mental Hygiene Institute, I beg leave to place before you a brief statement of the plans and purposes of the organization, its history, and its immediate needs.

The plan and purpose is set forth briefly in the attached statement.

It is the policy of the University to integrate logical units of research in the interest of co-operation of colleges, departments, and other agencies and services, and for the purpose of securing special funds for the promotion of research. See *Trends in Graduate Work*.[33]

The Iowa Mental Hygiene Institute assumes a new significance in connection with the proposal to establish a mental hospital for children. The place of such a hospital was fully recognized at the time the Institute was organized; but our policy at that time was not to ask for money for buildings, but merely to enrich and strengthen the local forces for work with facilities now available. Should it be possible to secure an appropriation for the mental hospital for children, that would give a specific allocation for the Institute and would realize one of its fundamental purposes.

As to the status of the organization, I may say that the attached statement is the result of the conferences of various interests in the University. This was recommended by the committee and approved by the president. It was not taken to the Board of Education for two reasons: first, it was felt that the character of the organization might be determined to a considerable extent by the sponsorship of some foundations; and, second, when time had been allowed for conferences with foundations, the sudden coming of the depression made it advisable to keep the plan in abeyance for the period of the depression. It was therefore not submitted to the Board of Education for authorization, although it was discussed informally with the board by the president.

Largely through the influence of Dean Houghton, Mr. Embree, representing the Julius Rosenwald Fund, became interested and came here for two conferences. The budget as finally adopted is essentially one that he suggested. He authorized us to make inquiries to discover available men and report back to him, the understanding being that on the basis of our discovery and recommendation of the right persons, he would welcome a request to the foundation and would formulate action of his board on the basis of merits in the case. With this understanding, your chairman, in co-operation with other members of the committee, made rather extensive inquiries; but as soon as the depression came on, Mr. Embree withdrew his encouragement for the time being.

It would seem that the present is, perhaps, a psychological moment to reopen negotiations, since our discussion and thoughts through the past four

33 Seashore, Carl E.: Univ. of Iowa Stud., Aims and Progress of Research, No. 33, 1931. [Editor: John William Ashton] Pp. 176.

years confirm the conviction that it is wise and timely, and particularly since at the present time steps are being taken to secure a mental hospital for children, which should be the home of the institute. The existence of the institute should furnish a most potent argument in presenting the plans for the mental hospital for children before the legislature.

The growing interest in preventive medicine and the rapid spread of agencies for the promotion of mental hygiene in particular creates a most urgent need for the establishment of this organization.

Therefore, with this brief orientation, I respectfully submit the plan to you in order that you may investigate its merits thoroughly and take such steps as may be feasible toward its realization.

Very truly yours,

CARL E. SEASHORE, Dean

The Iowa Mental Hygiene Institute

(A Program of Preventive Medicine)

Purpose

The purpose of this institute is to conduct scientific investigations on the nature of certain types of mental disorders and on methods of remedial and preventive measures applicable to these, to treat selected cases in the University Hospital and clinics, and to initiate preventive measures for mental disorders in the state.

Organization

The institute shall be organized within the graduate college somewhat on the order of the present Iowa Child Welfare Research Station. Although it will have an independent budget, it will function as an integral part of the University and will presuppose intercollegiate and interdepartmental co-operation on the campus wherever feasible as to personnel, equipment and services. Since the Psychopathic Hospital represents the medical interests in mental hygiene, both in the University and in the state, the director of that hospital should under ordinary circumstances serve as director *ex officio*. The details of organization are to be worked out progressively.

Board of Directors and Council

The deans of the graduate college, the medical college and the college of education, together with the directors of the Psychopathic Hospital, the Psychological Clinic and the Child Welfare Research Station, shall constitute a board of directors *ex officiis*. It shall be the function of this board to deal primarily with matters of appoint-

ments and general policy. The director, together with the three deans, shall constitute an executive committee.

The directors shall have a council composed of the chiefs of divisions now established or to be established from time to time. The function of this council shall be to serve in an advisory capacity in all matters pertaining to routine matters of operation of the institute not delegated to the board of directors.

Divisions and Scope

The institute shall comprise a number of subdivisions ranging from the Psychopathic Hospital at the medical end to the Iowa Child Welfare Research Station dealing with normal health, the purpose being to co-ordinate activities falling within the purpose of the station into a functional whole by recognizing all grades of mental disorder, inadequacy, pedagogical and social inaptitude, maladjustment or delinquency, and selecting from these for investigation and service from time to time those for which the institute may be able to provide adequate facilities. At the present time the psychological clinic and the training school are recognized as such additional units.

The Psychopathic Hospital. The Psychopathic Hospital in its present organization and equipment is admirably adapted as a center around which the institute may be built. Continuing its function as diagnostic center, clinic and research laboratory for the state, both in its ward and its out-patient services, this Hospital may enlarge and extend its activities into a special consultation service of professional character for cases not adapted for Psychopathic Hospital ward or out-patient services but coming more appropriately under the head of health guidance service. It is thought that through this type of extension into cases not recognized as clearly pathological, preventive measures may be enlarged and made more effective by treating of impending ailments in inceptive stages. Through this a new expanse and effectiveness may be given to preventive measures. This service will blend gradually into all the other services, the main emphasis here being made, however, upon the service to adult and adolescent cases rather than to children.

The Psychological Clinic. The term "Psychological Clinic" is inept, but designates adequately the scope of a suitable unit within the institute. It is distinguished from the Psychopathic Hospital in part in that it deals with the type of problems which the psychologist ordinarily encounters, particularly in social and educational services. It

is also distinguished from the Hospital, and particularly from the special consultation service of the Hospital referred to in the preceding paragraph, in that its field is limited to children. In general it comprehends the children's problems which lie between the psychopathic problems which shall be treated in the Hospital and the problems of a strictly normal child, which are studied in the Child Welfare Station.

As organized at the present time the clinic is subordinate to the Psychopathic Hospital and represents a fairly defined division of labor. It enjoys the medical service of the University Hospital and the training facilities of the college of education. It will serve as a receiving unit for the sifting of cases to be referred to the various services of the Psychopathic Hospital. Within this field the following projects are already in the inceptive stages and are recognized as suitable units:

I. *Speech Disabilities.* The primary object of this unit is to investigate the nature and the methods of treatment of all cases of speech disorders for which it may have facilities. The activities of the unit will in the early stages be directed primarily to the treatment of minor disorders of speech, most of which are remediable under prompt and suitable treatment. Among these the following sub-units can be put into operation immediately:

(1) The analysis and correction of speech disabilities among freshman students. The department of speech makes the analysis of all speech inadequacies at the beginning of the freshman year and a definite service is organized for class, individual and tutorial treatment.

(2) Speech disabilities of school children in the primary, elementary and secondary grades. While this service is not yet organized, it may be organized at an early date on the pattern of the college freshman sub-unit.

(3) Speech correction with post-operative cases in the various services of the University Hospital. For the present one speech technician may be employed to advantage in assignment to these services under the immediate direction of the head of speech pathology.

(4) Preventive and ameliorative service for stutterers. The Child Welfare Research Station has appointed a full-time research assistant to organize ascertainable facts in regard to the inceptive stages of stuttering in children and commendable compensatory action on the part of confirmed stutterers. Informative service to parents on matters of this sort may have extraordinary deterrent influence.

II. *Reading Disabilities.* In general this unit should parallel the various sub-units of the speech disorders. For some years studies have been made and corrective procedures have been conducted experi-

mentally to remove reading disabilities among college freshmen. It is a well-known fact that reading disabilities of remediable types are often a cause of failure in college. Indeed, infantile types of reading are often discovered among freshmen. Except where it is due to general low intelligence, these cases are ordinarily remediable and often change the student's entire outlook upon life. This project for college freshmen is provided for during the coming year on a small experimental scale following up previous findings.

With adequate personnel, parallel sections should be carried for primary, elementary and secondary grades, with special attention to the early formation of reading habits through instruction in school. For this work we have excellent co-operation with the department of elementary schools under the direction of Professor Ernest Horn, and especially in the work of the Child Welfare Research Station.

III. *Re-education in Cases of Inadequacy Due to Faults in Development or Previous Training.* This unit should be a sort of carry-all ready to undertake investigation and treatment in a great variety of cases of maladjustment not included in the foregoing and the following specified types. Re-education blends by imperceptible steps from the clinical situations into the improved and specialized methods for the eradicating of inadequacies in regular subjects in the schools, where many of these difficulties may be obviated by early recognition and adjustment.

IV. *The Treatment of Juvenile Misbehavior.* This unit is a specific clinic, logically belonging to III above, but organized separately because of the particular technique required in dealing with these cases. In the past a few of the most grave cases have come to the attention of the out-patient service in the hospital, but the service can be rendered on a very much larger scale, and the range of problems for investigation may be greatly enlarged, by provisions for a clearing-house under the psychological clinic to which children may be brought for assortment, advice and treatment. The psychopathic cases will, of course, be referred to the Hospital as soon as discovered by the psychiatrist in this service, but the large mass of cases are of a minor habitual behavior type which can best be treated by re-education process in a normal environment. For these a special hospital and training school will become necessary.

Training

The director of the institute will be responsible for organizing training in mental hygiene at various levels. This should include (1) an

improved position of psychiatry in the medical course; (2) courses for training of physicians in psychiatry; (3) courses in clinical psychology in which the major for the doctorate may be taken in psychiatry; (4) courses for teachers in the college of education in which the subject of mental health is treated as a cultural and informational subject essential in the training of teachers; (5) training of re-education experts who may qualify for special services; (6) psychometrists; (7) specialists in speech correction; (8) teachers in ungraded rooms.

Support and Expenditure

A general statement as to the scope and purpose of the institute and of methods to be used in treatment and in research work will be prepared as the basis of an appeal for funds. At the outset the amount of funds called for should be limited to that which it is foreseen can be consumed in research and therapy according to well proved methods. Proceeding under safe and assured technique should be fostered and strengthened.

If an adequate appropriation should become available, our policy should be to spend the money as largely as possible on personnel: full research professorships, and advanced research associates and assistantships.

There should be in *Psychiatry* one full-time professor, largely of the same point of view and training as the director and capable of dividing the work with the director in the conduct of research on the enlarged program.

There should be a full-time professor in *Clinical Psychology*, associate director of the psychological clinic, allowing Professor Travis to devote his time especially to the field of speech pathology.

There should be a professorship in *Re-education* to be placed in charge of the various re-education activities not specifically provided for by other appointments.

These three would be major appointments and should be filled only when highly qualified men become available for these respective positions, the theory being that the success or failure of the research program depends very largely on those who are at the head of divisions.

In the same program it is contemplated that one or two research professorships should be added in child welfare, where there is a most urgent need at the present time; but this will be taken care of by special budget for that station.

In providing for research assistants and associates, it would be better

to have a comparatively smaller number that would attract men of first-class training than to take on large numbers of untrained students. At the same time, the latter class must be provided for on a modest scale.

The Present Status

It is evident that upon actual inventory we find very considerable units within the scope of the institute now in operation. There are first of all the Hospital and the Welfare Station well financed and wisely operated. Within the field of the psychological clinic a considerable number of unassorted cases are cared for in the present clinic. The research in speech pathology has made unusually good progress in approaching fundamental problems with some promise of solution. In the university model schools we have the beginnings of the application of mental hygiene principles in teaching and learning.

From the point of view of staff, we have an investment which furnishes a very substantial starting point for the unified institute staff. With the limited resources for research available at the present time a careful survey should be made of the most immediate needs for which we could find suitable personnel if temporary funds for research and service of this type should be available.

Housing

The Psychopathic Hospital will continue to be used as at present. East Hall could shelter the beginning work in speech training, and after the clinic for juvenile maladjustment is under way, the training school for these patients could be organized in East Hall. The clinic for patients with emotional and personality defects could be carried on for the present in the University Hospital. As the different divisions grow and others are included a separate building should be called for eventually to house the whole institute.

Budget for Special Funds

On the above program funds should be sought for the initial year to cover, at a rough estimate, the following:

3 research professors at $7,000 each	$21,000
5 research associates at $2,500 each	12,500
5 research assistants at $1,800 each	9,000
5 fellowships at $600 each	3,000
Clerical service and materials	6,000
	$51,500

It is contemplated that this budget should be organized for a period of ten years with an increase of $5,000 per annum throughout the period.

In this initial budget it is contemplated that the University would furnish housing and the major part of equipment, and that the new activities would be essentially a natural extension of the activities already in some degree of operation. The program for the activities in accordance with this budget is clearly in hand and effective operation can be guaranteed.

After several conferences the committee has agreed upon the above as a minimum budget for special appropriation, but the committee believes that a budget on a larger scale operated on the same general principles would make a very wise investment in the interest of preventive medicine in Iowa. The whole program is, however, organized on the principle that we shall build safely and surely on foundations we already have in hand or in immediate sight, and plan for a normal growth of the institution. An analysis of the situation reveals the fact that under this program the University would be contributing far more than the equivalent of the minimum budget set out, and we are sure that it is the avowed policy of the University to continue support of a program of this sort.

The present relationships of the University to the state furnish a unique setting for the operation of a model preventive medicine program in mental health.

THE TRAVEL CLINIC

The establishment of school clinics, mental hygiene centers, and a variety of service institutions which cater to classes of young people who would hardly ever come to a mental hospital is a striking example of the mode of operation of this "middle ground" theory of psychology and psychiatry. A fundamental feature of these institutions is that they fit into the environment they are intended to serve. There is a logical division of labor between physicians, psychologists, teachers, and social workers. The same principle is developed in institutions for the feeble-minded, schools of correction, and a variety of other situations which are characterized by a well adapted policy of division of labor, mutual helpfulness, and service. But these cost money and can only be maintained in comparatively large centers.

As a substitute available for smaller centers, a traveling clinic has been developed and has been fostered by a number of national founda-

tions. Iowa has made a small contribution in this direction by making available a movable staff consisting of a psychiatrist, a psychologist, and a psychiatric social worker. This was first started through the co-operation of Dr. Orton and Dr. Travis and has been in operation intermittently since then but only on a small scale for want of funds to maintain the staff.

It was fully recognized that this was but a makeshift in preparation for a much larger and more elaborate service for the state. That the venture was sound as an initial step in the direction of state service is indicated by the extraordinary development of these services during the past decade under the leadership of the University with support of state and federal funds. In view of these developments, the travel clinic may seem a trifling venture, and yet it was one of the seeds which was planted and took root in state and national support through ventures under the New Deal. The idea of travel clinics is today, however, an important part of work for mental hygiene in the state.*

* In the '20's and '30's there was a movement in the direction of the development of schools which tend to integrate the operation of related departments by breaking down the traditional departmental fences and organizing under cross-section units. At the graduate level this has sometimes taken the form of an institute. In 1925 we prepared the following prospectus which may be of historical value as an indication of the ambition and vision of the department at that time. The depression, however, blocked this development.

I. *Name.* — The Iowa Institute of Applied Psychology.

II. *Objectives.* — The integration and development of psychological research in allied departments.

III. *Organization.* — (1) A central laboratory with dove-tailing branches in different fields. (2) A director, head of the department of psychology. (3) Work in each field under control of the respective departments. (4) A central budget. (5) Model of organization: present relations of psychology to psychiatry, child welfare, music, and speech.

IV. *Units now in operation.* — (1) The Department of Psychology proper devoted to fundamental science and theory. (2) The Psychopathic Hospital. (3) Educational Psychology. (4) The Child Welfare Research Station. (5) The Psychological Clinic. (6) The Speech Clinic. (7) The Psychology of Speech — Phonetics. (8) The Psychology of Music. (9) The Psychology of Art. (10) The Psychology of Poetry — English. (11) The Reading Clinic. (12) The Psychology of Personnel. (13) The Psychology of Physical Education. (14) The Psycho-physics of Otology. (15) The Psychology of the Deaf. (16) State Services.

V. *Some units that are ready for development.* — (1) In Commerce, the psychology of advertising and personnel. (2) In Engineering, the psychology of engineering personnel. (3) In Linguistics, experimental phonetics. (4) In Medicine, the psycho-physics of vision. (5) In Journalism, the psychology of writing. (6) In Zoology, animal psychology. (7) In Political Science, the psychology of government. (8) In Sociology, the psychology of crime, and social psychology. (9) In Health, mental hygiene. (10) In state services, the over-head leadership.

VI. *Budget.* — (1) Departmental budgets as now existing. (2) A research budget from outside sources under the control of the director and a board of three.

VII. *Fundamental principle.* — The allocation of distributed departmental responsibility for initiative and control of research in each field on the general plan.

ELECTROPHYSIOLOGY

At the time that Travis began his work, electrophysiology was coming to the front and was regarded as a basal attack upon problems relating to nervous disorders. He therefore undertook an elaborate program for studying handedness in relation to its possible bearing on stuttering. While the tendency was always to go into remote details which might or might not have a direct bearing on the problem under consideration, the training offered under Travis in this field proved most excellent as a field of concentration for the doctorate in clinical psychology. Such psychologists were produced at a rapid rate and had no difficulty in getting placed.

Then came the concentration upon brain physiology in the measurement of brain waves. Again, this proved to be rather remote from the central issue in the department but served to train the meticulously accurate experimenter. It was partly through seeing the remoteness in this that Dr. Woods was led to suggest that the electrophysiology laboratory be moved to East Hall, where it was going very strong at the time that Travis left in 1938.*

THE POSITION OF PSYCHOLOGISTS IN STATE INSTITUTIONS

It is difficult for those now operating in very elaborate federal, state and institutional services in which clinical psychology holds a central place, to realize how utterly foreign such ideas would have been thirty years ago. At that time, the vision of such enterprises was only on paper. In June, 1912, I read the following paper before the state board of control in Des Moines. It is placed on record here to show my very modest view of the situation at that time. It was merely the proposal of a pioneer, being limited by his view and existing conditions and regarded as a bold and untried attempt to promote the development of clinical psychology in state services.

I. *General View of the Situation*

1. The modern science and art of treatment of mental diseases is founded upon psychology. Witness the types of work represented by Kraeplin, Adolph Meyer, and Goddard.

2. But the science of applied psychology in this field is in the very inceptive stage. Witness the lack of organized facts, the place of

* It is interesting to note that in addition to the fully equipped laboratory in electrophysiology in the department of psychology at East Hall there is now an additional laboratory set up in practical aid to neurology in the University Hospital. This work is carried on by Dr. John Knott who was a student of Travis'.

psychology in the medical schools, and the empirical procedure in hospitals.

3. Yet enough foundations have been laid to encourage the employment of institutional technicians in psychology. Witness the work in psycho-analysis, the occupational adjustment movement, and the measurement of mental levels.

4. The psychologist will not "find" himself in the institutional work so long as he regards himself primarily as a research man. Witness the neglect of the practical for the theoretical, the diagnosis without treatment, the failure to get and keep the right kind of men.

5. What the State of Iowa now needs for the advancement of the science of mental pathology is two men: first, an eminent scholar and expert in clinical psychiatry at the University who shall devote himself to the psychiatrical clinic, the conduct of research, and limited consultation work; and, second, closely associated with him, a consulting psychologist who shall devote himself to the psychological clinic, the conduct of research upon mentally defective children, and the training of men and women for special work in the public schools and charitable institutions for children.

6. What the State of Iowa now needs in the charitable institutions is a corps of practical technicians in psychology who are not necessarily physicians nor consulting psychologists: we might call them simply "psychologists."

II. *Some Illustrations of the Function of Such a Psychologist*

1. To act as a scientific expert in the institution in sifting and adapting the results of research in applied psychology.

2. To be detailed for the adaptation and testing of new psychological methods of examination and treatment.

3. To act as an expert in the psychological study of special cases.

4. To offer courses of instruction for nurses and attendants from the point of view of applied psychology.

5. To conduct psychological research with a distinctly practical end in view.

6. To represent the institution in its relation to institutions for theoretical work in psychology.

III. *Some Critical Facts About Such A Position*

1. The demand for preparation must not be extravagant; the training in psychology should be thorough, but full medical course not required. Women might well qualify for the position.

2. The rank and salary should be about that of a physician, in order to give the profession attractiveness and stability.

3. The profession is that of practical psychologist — not superintendent, examiner, or physician, or a substitute for any of these. Yet, as technician, the psychologist is at the command of the superintendent and other members of the staff for the routine work for which he is peculiarly qualified, and this routine work is his main business.

4. The little research that he can do must be done on his own initiative or in co-operation with other research men, and not under the direction of the superintendent or the institutional physician.

5. This type of psychologist is not now available, but as the need becomes felt facilities for the special training and encouragement will progress.

6. In resume, psychology can be of great practical value, and we must pave the way for the recognition of a place for the eminently *practical* work as distinguished from the theoretical.

A STATE INSTITUTION FOR SELF-SUPPORTING MORONS

It is well-known that a large number of people properly classified as morons are engaged safely and profitably in ordinary vocations in society, often so successfully that they are not really recognized as morons. In modern schools for feeble-minded, the principle of self-help is often utilized in the treatment of institutionalized morons. There is a need for an institution between the school for feeble-minded and the occupations successfully pursued by high-grade morons outside of institutions.

In 1923, Dr. Orton and I prepared a proposal for such an institution and read a paper before the Iowa Medical Society.[34] We suggested that the state establish a farm and minor industrial units, and figured that if the original capital investment were taken care of by the state, the institution could be made self-supporting. It would be a colony of congenial, self-respecting individuals which would be a comfort to parents, who at present are encouraged to send this type of patient to institutions of detention.

It was recognized that the successful development of such an institution would require someone showing ingenuity in the development of policies and exceptional ability in management and routine handling of cases. Such an administration would have been very difficult to

34 A medico-psychological survey of morons in Iowa. Seventy-second annual session, Iowa State Medical Society, Ottumwa, Iowa, May 9, 10, 11, 1923.

find twenty-five years ago, but now with the insight into the nature of individual differences, the discovery of latent resources in the individual, the development of a variety of testing techniques, and the extraordinary rise and enlightenment of social attitudes, there should be no serious difficulty. Our proposal was ahead of its time, but even today I do not see any significant feature which I would change, although many new ones might be added. The theory was fundamentally sound. We are moving fast in the direction of recognizing this possibility.

Our proposal was based on the theory that if you assign to a child a task for which he has specialized capacity so that he can accomplish what is expected of him, he will be happy, useful and good. With the farm and some minor shop industries and, most important of all, housework, there would be enough talent among the recognized morons of Iowa so that practically all the actual work, except the management, could be done by them.

I got this idea from a study of the extraordinary features developed by Goddard at Vineland; a principle since then adopted by the leading institutions for the feeble-minded. Take, for example, cleaning. He had six types of cleaning: scrubbing the sidewalks and raking leaves; scrubbing the floors in the house; cleaning the kitchen; dusting and wiping furniture; what might be called the "decorator," who gathered and arranged flowers; and one who arranged and cared for the furniture. After having determined these grades of ability by experiment, he assigned each person to an appropriate task.

A moron does not get tired of doing the same thing over and over again so long as the overhead work is done for him. He is happy with his job because he feels that he can do it well and is proud of being a sort of specialist. I think that of the 500 children in the institution at that time, Goddard found enough to take care of these six grades of cleaning satisfactorily, and by the same principle, he found children to take care of much of the other work.

This principle has been developed admirably in our own institution at Glenwood, and the establishment of the institution for epileptics is a splendid outcome of the same idea.

One of the reasons for our proposal was that there is a vastly larger population which should be cared for in this type of institution than is now admitted to Glenwood. Many of this type of case are in our orphan asylums and in our various penal institutions. Children are not sent to the now existing institutions except in extreme cases, and

the placement of a child in an institution is looked upon as a public burden and social handicap.

We therefore suggested that all cases of persons not occupationally placed, if capable of sharing in self-support under prescribed conditions and not dangerous, be taken out of existing institutions and placed together in a self-supporting colony. Also, a large number of cases which need institutional care but have not obtained it under existing conditions should be added to this colony.

One of the humane conditions involved is the idea of self-respect of these people who are ordinarily repressed and unreasonably discouraged even in the best homes. They should be given the privilege of living in a society adapted to their needs and should have the right to take joy and satisfaction in a happy, adjusted life work, conscious of the fact that they are not associated with the lowest orders of mentality or criminal types. These morons are, within their limitations, exceptionally social-minded; and in a staggered program of employment, they would take great satisfaction in being of service to others.

A CHILDREN'S MENTAL HOSPITAL

It is well recognized at present that the most profitable approach to the treatment of mental disorders comes in early childhood and youth. It was a recognition of this that led to the early establishment of psychological clinics throughout the country.

Iowa has recognized the limitations of a makeshift psychological clinic even as operated in the out-patient clinic of the Psychopathic Hospital; and Dr. Woods has vigorously advocated the establishment of a mental hospital for children which would parallel the service of the hospital for adults and serve as a clearing-house and experimental service station for the state. He has drawn up plans for such a hospital and has had these presented before the legislature in recent sessions. It is hoped that in the near future provision will be made for this hospital paralleling the generous provision already made for our children's hospital, which is devoted largely to physical ailments. This children's hospital will have the privilege of reference services to various medical branches in the University Hospital and various adjustment units; such as, child welfare, psychology, and education.

It is hoped that when the final program of organization for such an institution is adopted, it will make very generous provision for training psychologists, teachers, and social workers through whose activities much of the work in the field must be done.

Chapter VIII

DIFFERENTIAL PSYCHOLOGY

In this chapter I shall deal with procedures in personnel services, educational practices, and clinical techniques which involve measurement of individual differences. These items are treated in a separate chapter since they were all undertaken as psychological experiments and the department's interest in promoting them lay primarily in the establishment of techniques of measurement and a search for fundamental psychological facts rather than in the development and maintenance of services.

I must again limit myself to a sketchy outline of origins of those features in which I had a hand in the initiative. Most of these are concerned with educational personnel problems because in the University of Iowa, the dean of the college of liberal arts, the dean of men, and the dean of women have looked to psychology for leadership in the development of techniques in this field. On the other hand, I was led to take the initiative in many of these situations because of my fundamental interest in the significance of individual differences revealed by psychologists. Each item discussed in this chapter represents a unit in applied psychology which has branched out into numerous types of techniques of service and deserves a history of its own, even within the walls of this University.

INTELLIGENCE TESTS

In 1895 I spent some time with Binet and Simon in Paris, discussing the possible nature and purpose of the now-famous Binet tests. With this began my growing interest in the possibilities of differential psychology and the extension of measurements beyond the walls of the laboratory.

The day we entered the first World War, President Wilson asked the American Psychological Association for an immediate report on what psychology could do in selecting and developing an efficient personnel. Professor Yerkes, then president of the association, called the living ex-presidents of the association to a meeting the following day. We met for dinner in the faculty club of Columbia University and by

nine o'clock had passed a resolution to organize the now-famous Army Mental Tests. After the resolution had been passed, we sat around the table discussing the project until two o'clock when practically all of us felt uncertain about the possibilities implied; but as we had already caught the spirit of war psychology, no one was willing to prove a slacker by moving reconsideration. Immediate steps were taken to set a staff of psychologists to work on the development of the tests, now generally known as mental tests. They were primarily tests of certain types of intelligence. The nature of these and the service they rendered in the war, and in the period immediately following it is well documented in the history of the war and of psychology, notably in the large volume edited by Yerkes.[35]

After the war, interest in the possibilities of this type of test for organizing student personnel spread fast and often furiously. President Jessup charged me with the responsibility of introducing this service as a means of analyzing the freshman class in the University of Iowa. This was in the summer of 1923 when the faculty was not in session, and he took advantage of that by making the recommendation an executive order, well knowing that if it were laid before the faculty, it would certainly not have carried. Accordingly, he charged me with the responsibility of rendering a service by providing and administering an intelligence test to every entering freshman as a psychological experiment.

We had already been experimenting with the Thorndike intelligence test, which was largely an out-growth of the Army Alpha; as it was the best available at that time, we organized the freshmen in army fashion in the Armory and followed the army technique developed for the administration of a three-hour examination. The ordeal was shocking and baffling to many freshmen, and the occasion for gross misinterpretation by students and faculty. I was out of town at the time of the first faculty meeting following this performance. Upon my return my friends intimated that my absence had been fortunate because the faculty had wanted to burn me at the stake. It was reported that one of the most distinguished professors wept copiously as he reported the ordeal to which the freshmen had been subjected!

However, Dean G. F. Kay calmed the turbulent water by saying,

> "The deed is done, and I would recommend that we take no action until Professor Seashore and his staff have had one semester to report on the

35 Yerkes, R. M. [Editor]: Psychological examining in the United States army. Memoirs of the National Academy of Science, 1921, 15, Pp. 890.

workings of the scheme as a means of predicting the academic success of students."

At the end of the first semester, we made a chart about thirty feet long showing graphically the progress made by two groups, the lowest ten per cent and the highest ten per cent, respectively, in achievement on the test and in performance the first semester. The showing was very striking. The lowest ten per cent had practically been identified as unfit for college work by early withdrawal, recommended dismissal, and failures in grades. This was probably one of the first times a report of this nature had been made to an academic faculty on such a devastating scale.

The report on the highest ten per cent was illuminating because these students tended significantly to appear in the highest ten per cent of achievement during the first semester. There were, however, a number of important exceptions; and a careful history of each case was reported, revealing the operation of a number of other factors besides intelligence that account for failure of achievement on the part of superior students in the freshman class. Among these were poor motivation, emotional upsets, economic hardships, love affairs, and excessive outside work.

The faculty at once saw the significance of the possibility of elimination before admission, or soon after, on the basis of such evidence, and also the possibility of follow-up work in the motivation of achievement on the part of the superior group.

As a result of this finding, I, as dean of the graduate college, seeing the significance of superior achievement in undergraduates for the planning of graduate work, interviewed each of these students in the highest group. The dean of the liberal arts college soon took up the responsibility for such interviews and appointed a special adviser as a guide to each of them.

The department of psychology had already secured the support of the president and dean of liberal arts; and after this showing, the project was approved without significant dissent in the faculty. Those of us who sponsored the tests were fully aware of the fact that they were in an experimental stage, that intelligence is not the sole factor determining fitness for college work, and that the tests should be used judiciously and sympathetically in confidential conferences between students and members of the administrative staff. With this strategy began the now varied operations for psychological analysis of college students. If the matter had not been made an executive order, the

adoption of such procedures would probably have been postponed for years.

However, the findings were drastic and did not meet with popular approval in the state. At the opening of our radio station I was asked to give one of the first talks, on the subject "Who should go to college?"; but after conferences with the administration and other members of the faculty, whose judgment I respected, I changed the subject at the last moment to "Dreams."

I had occasion to discuss with the president his courage in ordering the collection of the facts and the characteristic wisdom of the administration in not going too fast against popular opposition in the application of them. However, the idea of analyzing the intake of the University by preliminary examination eventually became well established. The technique has been improved from year to year since this first venture, although we have not been able to make it a basis of selection before admission.

The State University had no authority to limit admission by such procedure. I therefore advocated the establishment of a state-wide examination of this type to be given to every high school senior so that the information could be available to parents and students before the latter are admitted to the liberal arts colleges of the state and can serve as a means of self-guidance at the source. The nearest approach to the realization of that in Iowa has come in the successful operation of the state academic "derby," in which the majority of high schools, under the able direction of Professor E. F. Lindquist, co-operate by administering a series of measurements of achievement in high school subjects. But the findings in these contests have not been implemented to make them an effective means of selection for college entrance. However, the actual procedure which I proposed was practically the same as one later set up for the state of Ohio, which has rendered a great service to the colleges of that state.

The question of the University's right to utilize this type of information came to a head when our dental college changed from a three-year to a four-year course and there was an inrush for registration the last year the three-year curriculum was in effect. President Jessup called me in for a conference and said: "We have 273 *bona fide* applicants for admission to the dental college this fall, and we have only 125 chairs. Have you any suggestion as to how we can handle this situation?" I replied that I would try it.

This presented an opportunity to try one feature of our scheme for

selective admission; namely, preliminary information about fitness for the work. Accordingly, I proposed that we give a qualifying examination in four of the large cities of the state in June, with the provision that new applicants might take a similar examination at the University before registration in the fall. We made a make-shift examination consisting of an intelligence test and a few specific tests of ability to do the things expected of dentists. This feature of attempting to sample natural aptitude for specific skills in a particular profession was then relatively new, although based upon successful experience in the army personnel service in which I had taken active participation in several respects during the period of the war (notably, selection of listeners for detecting submarines and selection of students for special training in various war services).

As we had anticipated, the announcement of selective admission led some who did not feel confidence in themselves to withdraw. Others who took the test and made a discouragingly low grade showed good judgment and withdrew, so that the number of applications was reduced to 137, who insisted on the right to register. The lowest twelve in our records were interviewed sympathetically when they arrived to register. Eight of these withdrew on their own accord after analysis of the situation and a friendly warning, but four still insisted on registering. On the recommendation of the dean, the president ruled that these four might register in liberal arts; and if their achievement the first semester was satisfactory, they could be transferred to the dental college. All four fell in the lowest ten per cent of the general intelligence test administered at the opening of the semester; and, as I recall, none of them asked to be transferred or was given the privilege.

This finding of factors which operate in elimination when concrete evidence of unfitness for the work is available before registration, was rather revealing and threw much light on the significance of an all-state qualifying examination in the interest of wise self-direction on the part of students, which I had recommended.

We were then in the midst of a rapid increase in registration by an influx of students to the University. Accordingly, the president, encouraged by these two experiences, said:

> We must take a few years to develop a technique by which we can put some type of selective examination into operation in this University.

Our experience up to that point therefore became the tap root for the development of college qualifying examinations of the objective type.

OBJECTIVE ACHIEVEMENT TESTS

Iowa was one of the first institutions to introduce the objective examination, beginning with true-false questions. We began experimenting with it about 1910 and gradually introduced it as one-half of the regular monthly examination in elementary psychology, the other half being of the essay type. Dr. Mabel Clare Williams, in charge of the material, made item analyses in each examination for a period of years, and gradually validated types of items so that for each successive examination, faulty types were eliminated and the number of valid types was increased. This gave us much insight into the respective faults and merits of the objective examination. At the same time studies were made on the parallel essay types, developing methods of raising the validity of the ratings on these questions.

Since the classes were large and there were several instructors, efficiency of the readings was introduced by parceling out the questions among the different instructors. Thus, if there were ten questions, each instructor was held responsible for two. This facilitated reading by making the reader more familiar with the general run of answers and more critical in handling his two items. It also resulted in pooled ratings on the essay questions so that each student was judged by his own instructor and by four others. The practice of distributing grades on the basis of ability of normal distribution for the entire class with specified percentage of cases allowed for each grade mark was followed. In this pooling, ratings on the essay type and the separate ratings on the objective type were combined for a single grade. This gave a certain objectivity to a fair distribution in pooled grades on the basis of the two types of examination. In the parallel operation of these two types, were found a number of cues for refinement of the essay type, notably in the direction of constructing the essay question on specific and countable items which set out specific and countable features to be treated.

Extensive technical investigations of objective types of examination were undertaken in the department, especially by Professor Knight and later by Professor Ruch and Dr. Stoddard and their associates. As new types of objective examinations were thus developed and as critical evaluations accumulated, we aimed to take advantage of this in setting the examinations in elementary psychology. The practice of using objective tests was gradually introduced into various courses in the department and spread into other departments.

During the early experimental period I conducted a series of con-

ferences for which I privately gave invitations to one of the younger and more progressive instructors in each of several departments without making the operation of this seminar generally known. We reviewed the theory and working of objective examinations, the object being to acquaint various departments with these new possibilities by encouraging each representative to begin experimenting for himself in his own classes and by giving us new types of content for critical study, as in mathematics, chemistry, English and the classics. The idea was that this would attract attention, and if favorable, would lead to spread of their use in the various departments.*

This stressing of objective examinations in elementary psychology led to a new point of view in regard to securing the best results by instruction. The idea was that it is quite possible to utilize examinations more immediately as a means of motivation where a student can be set to work on interesting projects in which he can check his own progress and the instructor can evaluate the quality of his work by a systematic observation of the way in which he works on his assignment.

This gradually led to the development of the project method, in which the examination became a part of the teaching device. Students were given access to the required books, together with an outline of the project for the month and a check list of the leading topics on which the examination would be based. They were thus given a clean-cut objective and facilities for observing from day to day the nature and rate of their progress in mastering the assigned material. The examinations were given each month in two-hour periods under supervision. The manual of instructions carried a completion test for each unit studied, and the students used that again as a check list as they filled it out while studying.

I am, however, more and more convinced that after we have made such splendid progress in the refinement of techniques of examination, we shall make less and less use of examinations, centering our efforts of instruction in the development of types of motivation which will

* In issuing these invitations, I had not invited a representative from one of the large departments because the head of that department had openly criticized and ridiculed this "psychological fad." But one day the telephone rang during our meeting and this same person, having got wind of our conferences, demanded that I explain why his department was not represented. I politely told him that it was because his department had openly expressed disapproval of this type of examination, but if he desired, he might send a representative to sit in with us. He did this, and as a result his department became one of the first to develop enthusiasm for the objective examination and one of the most aggressive sponsors for the serious development of it in its field, locally and nationally. For years, an advanced student of psychology was invited to sit with the staff of this department in considering the development of pedagogical procedures which were the outgrowth of the adoption of the objective examination.

inspire enthusiasm for achievement on the part of the student. This should eliminate cramming for examinations, giving the student encouraging orientation for self-help, sustained effort, and self-rating.

THE IOWA COLLEGE QUALIFYING EXAMINATIONS

Soon after the war I served on a committee of the Society for Promoting Engineering Education, organized under a generous grant from the Carnegie Foundation. At the first meeting I was asked what I, as a psychologist, would recommend offhand to improve the situation. After due consideration, I suggested two things: first, the introduction of a placement examination given to all entering students as a means of analyzing their general fitness and of determining types of ability; and second, the introduction of the principle of sectioning on the basis of ability in large classes. Both of these proposals met with favor and became projects for experimentation in the engineering colleges of the country. As to the first, I was asked, "Are there any examinations suitable for that purpose?" to which, of course, I had to give a negative reply. The next question was, "Can you assume responsibility for organizing the preparation of such an examination?" and this responsibility I accepted.

That was in July, 1924; and the committee, consisting of deans of engineering colleges, requested that if possible such an examination be made available for the opening of the first semester in September. I was fortunate in securing the co-operation of Professor Ruch and Dr. Stoddard, who were unusually competent and familiar with this type of work; and with the aid of a selected group of assistants, we developed the first two forms of the Iowa college qualifying examination. As I recall, the term "qualifying examination" came into use in a conference I had with Professor Thorndike and Dean Hawkes, who were at that time moving in the same direction at Columbia University.

In the organization of this effort to set up a college qualifying examination, we introduced distinction between two features in the examination: namely, aptitude for the pursuit of each of the main subjects covered, and achievement in each of them, by dividing the examination into two units, aptitude and training. This distinction was based upon my experience in distinguishing between the influence of heredity and the influence of environment in music education. We realized that no sharp line could be drawn between aptitude and achievement and the testing of them; but the recognition of some possibility and the adoption of the plan gave momentum to this type of

distinction, now generally recognized in our qualifying or placement examinations of all kinds, whether set up in separate examinations or merely taken into account in the selection of items in a single unit examination.

One of the basic elements in these examinations is the technique called comprehension test as applied to content material in each field. I had developed and experimented with this for a period of two or three years, and my confidence in the possibility of making a general qualifying examination covering a limited unit of time was based largely upon my successful experience with comprehension tests as in part a measure of specific types of intelligence.

That fall, the Iowa qualifying examination was accordingly adopted as an experiment in many engineering schools, and the University of Iowa substituted it for the intelligence tests previously used. The success of that experiment in the engineering schools ran beyond our highest expectations. A large number of colleges of arts and science also adopted and have continued to use the Iowa examinations.

I take off my hat to my colleagues for their great ingenuity and well directed energy in devising these first examinations. The launching of this service became a successful pioneering venture along a new frontier and now holds an important place in the selection and administration of student personnel. The success of these examinations is due largely to the continuous self-sacrificing and skilled progressive development of them by Stoddard and his associates in various departments.

This movement was undertaken as an academic venture without personal gain for those who originated and have continued to develop the tests. In providing this service through our extension division, not only for Iowa but for the country at large, our policy has been to make it a self-sustaining service without financial profit to members of the staff engaged in the service or to the University. No outside sources of support have been sought or accepted. Considering the wide use to which these examinations have been put in competition with ventures which are similar in aim but have been highly endowed from foundations or undertaken as commercial ventures, Iowa has received and deserves distinguished recognition.

As an outgrowth of this first step, there have followed in rapid succession a great variety of specific departmental placement examinations which become more and more effective as they are restricted to a specific field and can be fractionated for significant features within

such fields. One great advantage in this departmental development lies in the fact that the information is sought by the staff in a specific department or division and is therefore certain to be utilized in a sympathetic and constructive attitude; whereas the original qualifying examination supplied by the general administration tended to be regarded merely as informational. Each department supplements the general qualifying examination for freshmen by these specific placement examinations. One of the first of these was the placement examination in engineering developed by Dr. C. V. Mann. It differentiates aptitude for different branches and subjects in engineering.

There soon followed the development of placement examinations to supplement the general qualifying examinations for each of the professional colleges of the University such as, law, medicine, dentistry, and other large divisions. Some of these examinations are now supplied by national agencies.

ORIENTATION TECHNIQUES

One of the topics which I frequently presented in the Gifted Student Project was the introduction of orientation services, particularly a "Freshmen Week," which has now come into general practice for college freshmen. The problem of determining how long this "week" is to be and what activities shall go into it, has found a great variety of solutions. The most significant has been the introduction of diagnostic examinations which aim to give each student an objective profile of his basic abilities.

Our department of psychology has progressively developed a number of such specific examinations which might be entered as items in an aptitude and achievement profile, and progress has been facilitated by asking each department concerned to make such examination within its own fields during the first week of the semester. The drawback has been that it comes after registration and therefore cannot be taken into account in registration. For many years I have urged an extension of the freshmen "week" to include the general qualifying and specific placement examinations, before the students register.

In this matter I made a rather drastic suggestion in 1939 [36] for a placement period with special reference to junior colleges where educational guidance is an important factor. This suggestion has the following features: The freshmen are required to meet for two weeks before registration to participate in a self-measurement program. A

[36] The Junior College Guidance Program, Junior College Journal, 1939, Vol. 10, 5-6.

systematic and co-operative self-examination of the student is substituted for the traditional faculty-dominated type. The student is regarded as a guest of the college and is supplied with the best facilities for self-analysis, self-rating, and self-guidance in relation to the organization of his program of studies.

For the experimental period, I suggested the following plan:

> For each day let the student take one basic qualifying test. To illustrate the procedure for the first day, let us assume that the subject is vocabulary, which is a very important index to natural resources and promise of achievement in student life. It is also interesting; sometimes thrilling, and sometimes shocking. During the first hour, give, for example, the best available vocabulary test, timed exactly to one hour. This may be given in a large room to large classes and all entering students should take it. During the second hour, let the conductor read or give out the key and require each student to check his own paper. This done, ask the students to exchange papers and recheck selected sections to obtain an index of reliability of the checker. Then let each student take back his own paper and perform the prescribed computations leading up to appropriate summaries. Next let the instructor read or give out the norms in percentile or decile rank and require each student to record this item on the record sheet to make it the first entry in a profile blank which the student has been directed to carry with him throughout the week. Thus the original record goes back to the office, but the student has the significant returns for the day in terms of the record on his personality chart which he himself is making. This session may then close with a highly selected list of references which the student will find in the reading room and may follow up at his convenience.
>
> Early in the afternoon have the most competent expert on the subject under discussion give a practical interpretation of the significance of this item in order that the student may realize impressively exactly what it means and what it does not mean for his future as a student. Let this be followed by small informal discussion groups. Then the latter part of the afternoon may be devoted to outdoor sports and other outdoor activities, and the evening to pleasant entertainment and social relations, student controlled.
>
> Thus at the end of the first day, the student will have found a method of studying himself in his own interests, will have learned the significance of individual differences in vocabulary, and will have had incisive training in how to work in college.[37]
>
> A similar procedure may be followed each day dealing with one particular item which would enter into the profile of fitness for college work. What tests should be given depends on the character of the institution and the student intake. In general, such subjects as vocabulary, intelligence, vocational interests, reading ability, and personality rating should be required of all students. These should be followed by specific departmental placement examinations indicated by the students' revealed interests, such as

37 *Ibid.*, p. 5-6.

English, general science, mathematics, and specific types of artistic talent. On the final day, the student should be required to write a brief account evaluating his previous educational experience and outlining his present educational plans and purposes.

By the end of that week he will have a dozen entries on his personality profile, will understand what each one means theoretically and for himself personally, will have had training in the best available methods of scientific analysis, and will begin to feel at home with himself in a very realistic way. He will have found out these things for himself and will have begun to feel that this is the most valuable kind of knowledge he can get in college. We may well challenge comparison of the investment of these two weeks of training with the achievement in the first two weeks in traditional procedures.[38]

Since the records for each examination are completed on the day of the examination, each student and each faculty member having charge of the registration will have all information available for guidance in registration.

While this two-week orientation program is uniquely adapted to the junior college situation, I venture to predict that the same general policy will be adopted for progressive standard colleges for analysis and guidance of their intake in the junior division. A strong argument for this orientation period can be made purely on the ground of superior instruction, in which the student is aided in a systematic effort to analyze and discover himself, a particular bit of information which is of critical value to him at that stage. It can be made a period of awakening and a turning point in his career, as it draws attention to the possibility and significance of a deliberately chosen and planned education. There is a great advantage in this differential treatment of freshmen in which the faculty is free to devote its best energies to the entering class and all unite in the effort to interest the student in the discovery and evaluation of himself. The experiment will always be effective in furthering a student-centered education.*

PRE-COURSE EXAMINATIONS

During the first year of the operation of the project room in elementary psychology, an incident occurred which gave food for thought in that a student who was rated in the highest five per cent on the basis of his college qualifying examination made a grade of C (average) in his objective examination and was failed on the basis of observa-

38 *Ibid.*, p. 6.

* I have recently developed a plan for offering this service as a summer session program in one or more of the universities best equipped for guidance. That could draw students from all parts of the country and prepare them for registration in any college.

tion of his attitude in the project room. The student knew his rating on the examination and therefore took his case to the dean, who called me on the carpet, demanding an explanation. My explanation rather startled him as I said that this student had accomplished practically nothing in the course because he was just a plain loafer. I said that with his ability he might possibly have made a grade of C if the examination had been given at the opening of the semester and that he should have been capable of making an A-grade if he had worked. This assertion seemed preposterous to the dean, and I therefore volunteered to make a test case to see whether or not my opinion would be sustained.

We took three engineering students, who had a similar rating in intelligence but had no record of having studied psychology, and gave them the same examination that had been given the student in question. They all passed with a fair grade.

This situation raised two critical issues in differential psychology: first, have we the right to expect a student to achieve somewhat in proportion to his ability?; and, second, under such circumstances, what precautions should be taken in scheduling students for an introductory course? In many subjects like psychology, such as history, sociology, economics, English, education, government, general science and arts, a superior student who reads newspapers and magazines, browzes in current books, studies underlying subjects, associates with intelligent and well-informed people, and follows his natural bent of independent thinking, may acquire much more information about the subject matter of an elementary course than is set up as a standard achievement for that course. This, of course, does not hold for subjects having high and basic technical content; such as, mathematics, the material sciences, and other subjects involving specific skills.

In elementary psychology we introduced the practice of giving a standard examination during the first week of the course as a means of discovering students who could profit by taking a more advanced course. Naturally, the main body of students could not pass such an examination but were told to try it as a sample of the sort of thing they were expected to learn. Those who made a passing mark in the examination were immediately encouraged to shift their registration to a more advanced course. In a number of cases, I had the boldness to register such a sophomore for individual work of the type given to honor students, there being a course entitled "Readings in Psychology" announced as a sort of carry-all for that purpose.

I cite this case as an illustration of the need of courage and progressive spirit on the part of the instructor. A younger man might easily have been discouraged by the reprimand of the dean; it did not phase me, as an older colleague and independent investigator of the subject. And a young instructor might well have hesitated to demand a change in registration of a student who was enrolled in accordance with the well standardized requirements for prerequisites. At the present time, teachers readily identify the superior student, but what does the administration encourage him to do about it?

In the elementary and primary grades, it is now conventional to test the student at the beginning of a course to determine whether or not he has already acquired through extra-curricular channels the achievement expected to be gained in that subject. Thus if he can spell all the words in spelling, can work all the problems in arithmetic, and can read well, he is excused that semester from these subjects. A child may be advanced from grade to grade without ever having instruction in spelling, reading, or writing. It will be a long time before such a practice will be adopted at the college level.

On the other hand, such a preliminary examination may reveal the fact that the student is not prepared for the course and should be sent back for makeup work for which the need is indicated by an appropriate examination.

SECTIONING ON THE BASIS OF ABILITY

About 1907 we began a series of pioneer experiments in sectioning students on the basis of ability in the elementary course in psychology, a practice which had fallen into disuse. In undertaking this we had to meet certain issues; such as, a technique for preliminary sorting, avoidance of conflicting classes, provision for fluid promotion and demotion in the section, and a choice of instructors with reference to their natural proficiency in handling superior or inferior students. We gradually solved all these problems.

In 1921 I read a paper before the division of educational relations in the National Research Council pointing out the possibilities and ways and means of reviving the process of sectioning on the basis of ability in the interest of motivation and efficiency of instruction. The practice had been introduced more than one hundred years before and had operated easily in a college with a single curriculum; but when the elective system increased the complexity of schedules, sectioning on ability gradually went out of practice on the theory that the

schedule could not be arranged without conflict of classes. However, on the basis of experience in elementary psychology in Iowa, I pointed out that: (1) if there are two or three sections which can be scheduled for different hours of the day, that freedom of choice will eliminate practically all reasonable conflicts with other courses; (2) the preliminary sorting should present no difficulty, if provision is made for promotion or demotion at frequent intervals by exchanging students from time to time among the section leaders so as to maintain a homogeneous group on the basis of current achievement; (3) such shifts can be made without difficulty providing there are two or three instructors in the course so that sections of different levels may meet at the same hour; and (4) the real difficulty lies in finding instructors who can deal competently with the best students.

My recommendation met with approval in the division and became one of the central issues in the Gifted Student Project which was presented to faculties throughout the country. It was soon taken up by the American Association of University Professors, The Association of Land Grant Colleges, the Board of Investigation of Engineering Education, and numerous other agencies in addition to departmental associations and local committees, operating in their respective fields.

In 1926 a survey of progress in the introduction of the procedure was published by the American Association of University Professors [39] as a report for Committee G, the committee on methods of increasing intellectual interests and raising the intellectual standards of undergraduates. It showed that within a period of less than five years more than half the leading colleges and universities had undertaken experimentation in this projcet in one or more of their departments. It seems that publication of the fact that there was no necessary conflict in sectioning large classes came as news to most of the institutions and became an encouraging factor in the introduction of the method. The proposal also had the advantage of coming in at the peak of the great influx of elementary students into large classes. I speak of this technique under the topic of differential psychology because, where well operated, it has proved a most helpful means of discovering the individuality of students, their natural needs, the relation of achievement to intelligence, and, in general, a natural means of placing the student in a favorable position for appraisal and guidance in relation to capacity and interests.

39 Sectioning on the basis of ability. American Association of University Professors, Vol. 12, No. 2-3, 1926.

It has also served to differentiate instructors. Many instructors enjoy and show great ingenuity in helping the most backward students, and frequently develop skills in the art of teaching at this level. On the other hand, an instructor of that patience and pedagogical bent of mind would prove quite helpless and useless in the motivation of superior students; since, in superior sections, one often finds students who have even higher natural ability for the pursuit of a subject than has the instructor.

The greatest danger in operating this practice with college students, which has also been revealed in the operation of two or three track levels in the elementary grades, is the danger of making the original placement fatalistic. For want of a little ingenuity, teachers will continue a student for a whole semester at a level for which he was sectioned by preliminary examination. This is unnecessary and deprives the practice of most of its advantages by taking away ambition for progressive self-adjustment on the basis of evidence of capacity for achievement. It is a comment on the sterility of the teaching staff that so many experiments in sectioning have failed because of the instructor's inability to recognize ways for avoiding the fatalistic and stagnant attitude. The purpose of sectioning is to keep the student at work at what is progressively revealed as his natural level of successful achievement.

The practice also tends to pave the way for honors courses for which the students in the superior sections are prepared.

The most striking feature in the whole process is the fact that by this means a considerable number of naturally able students with unmotivated talent for the first time discover themselves. They become shocked at their servile attitude toward a passing grade, and conscious of the fact that they can pursue subjects which have vital relations to their levels.

VOCABULARY TESTS

Words are the names for ideas. There is an enormous difference in the sizes of college students' range of ideas. There are many eighth grade students who have larger vocabularies than a number of college freshmen. The size of vocabulary can easily be measured with a high degree of validity and reliability, and we can differentiate vocabularies; for example, words the meanings of which are recognized, words which can be used correctly in a sentence, words as an index to achievement in a course, words revealing natural aptitude in a given

field of knowledge not pursued in courses, and the vocabulary actually used by the student in speaking and writing, or the vocabulary used by Shakespeare or President Roosevelt.

It has been shown that a vocabulary test adapted for a specific purpose is a given index to a given type of intelligence and that it may well be used as a tool for the organization of instruction and the placement of pupils.

Professor Ernest Horn is an outstanding authority on this subject and has perhaps done more than anyone else in making a practical application of knowledge of children's vocabularies for understanding children in the elementary grades and for utilizing this understanding in the organization and pursuit of instruction in elementary subjects. It will be a long time before teachers at the college level will acquire a similar grasp of the meaning of the subject or the art of using this knowledge with college students.

For many years we have used standardized vocabulary tests at the opening of the elementary course in psychology, with much profit. The general vocabulary test now used is that designed by my son, Robert H. Seashore, and published in our manual of elementary experiments.[40] The student is entitled to know his rating on vocabulary and should be taught its significance, as a pedagogical whip or as a reward and means of encouragement for enriching an already rich vocabulary. A good vocabulary test does not carry with it the onus which conventionally attaches to an intelligence test. It may be used for orientation in regard to specific course material in achievement; but it should be cultivated more extensively in the interest of stimulation for the development of personality.

SPECIAL DISABILITIES

The analysis and measurement of disabilities in reading, speech, and music have been described in preceding chapters. They deserve mention here as good examples of the measurement of individual differences, for immediate adjustment and treatment in the clinics, and for orientation in each of these arts.

OTHER PERSONNEL SERVICES

The basis of all personnel work is significant and reliable knowledge of the nature of the individual as, for example, natural capacities,

40 Seashore, Carl E. and Seashore, Robert H.: Elementary experiments in psychology. (Revised) New York: Henry Holt and Company, 1935, Pp. 1-6.

achievements, disabilities, and personality. Among these are mental health, individual guidance, and child development.

It is well known that in the ordinary student body there are a number of cases in which psychiatric or neurological problems have arisen. Since the establishment of the Psychopathic Hospital we have had adequate facilities for referring such cases to it as early as they are discovered. But even before the establishment of the hospital, I was aware of the importance of identifying these cases and was active in arguing for their early discovery and the development of means for adjustment in the early stages of the disturbance. From my long experience with college students, I can see how a large number of my student acquaintances who have become neurotic and psychopathic could have been saved from this disaster by a proper recognition of the danger.

There are certain natural obstacles to giving a general entrance examination in mental health corresponding to the physical health examination now administered soon after admission. The best the University has been able to do in recent years is to have a psychiatrist in the medical group which makes the physical examinations. Thus arrangements can be made at the time of the physical examination for routing any student who gives evidence of some mental health problem or nervous condition to the psychiatrist. This gives the University service in psychiatry an opportunity to identify cases and route them for further examination and treatment if so indicated.

One of the means used in various situations is the personality rating scale in which a prominent section is devoted to identifying nervous or mental inceptive conditions. But these scales are in a formative period, and we have no adequate system for following up the findings, except through the offices of the dean of men and the dean of women.

The problem of educational and occupational guidance is coming to the front. As dean of the graduate college I always considered it my function and responsibility to make a rather penetrating analysis of the personality situation of entering graduate students with reference to further orientation. In the fields of music and speech, my work in this direction with children is perhaps well known.

Yet I have taken the stand that universities should not offer any considerable number of specialized courses in training for either educational or occupational guidance. We have given numerous master's degrees and an occasional doctorate for research in this field, never as a result of a fixed course of study but always with emphasis

upon research on some selected technical issue. In this we have drawn not only on education and medicine, but even the basic sciences.

I mention last the problem of child development and achievement for which the University of Iowa is justly famous through the activities of the Child Welfare Research Station. But this deserves a chapter of its own.

Chapter IX

GENETIC PSYCHOLOGY: THE IOWA CHILD WELFARE RESEARCH STATION

The field of human genetic psychology has had an unusually fortunate existence in the University of Iowa through the establishment of the Iowa Child Welfare Research Station, which has developed a program of research in genetic psychobiology of the normal child perhaps unparalleled in any other university. The presence of a large number of psychologists devoting their entire time to scientific studies on the development of the child by carrying on a stabilized program of research and directional organization of services with adequate support and ample facilities and affiliations on the campus, has been a boon to genetic psychology. The story of the early stages and the development of this station is well told in two monographs, *Pioneering in Child Welfare* [41] and *The Second Decade*.[42] My comments on this project will therefore be limited to a few reminiscences and mention of a few of the projects within the scope of the station during the period here covered.

CHILD DEVELOPMENT

The Iowa Child Welfare Research Station owes its existence to Mrs. Isaac Lea Hillis, a woman of rare abilities, progressive in sound enthusiasms, and, like her father, a general in situations which required great executive ability.

Mrs. Hillis was impelled by one fundamental idea; namely, that the state should engage in scientific research bearing on the betterment of the normal child in Iowa, somewhat after the pattern of research on animals and plants at Ames. The slogan "Child culture v. corn culture" immediately drew effective attention from the parents of the state.

She first broached her project at Ames but found no encouragement there, because it did not fall within the scheme of their organization

41 Stoddard, George D. and Bradbury, Dorothy: Iowa City: The Univ. of Iowa Press, 1934.

42 Stoddard, George D.: Univ. of Iowa Stud., Aims and Progress of Research, No. 58, 1939.

and interests. She then approached three successive presidents of the University of Iowa and finally gained a favorable response from President T. H. Macbride, who suggested that the matter be referred to "our psychologist, the dean of the graduate college." She immediately came to me and made such an impressive presentation that I promised to sponsor the cause in the University and formulate a scientific analysis and statement of the project.

From that day on, Mrs. Hillis and I became a team. She bore the brunt of the burden in the extraordinary work among the women of the state in an effort to create a sentiment in favor of such an undertaking and to impress the legislature, and I faced the issues at home. This proved a wise and effective division of labor. It was interesting to see how a woman with such warm inspirations and towering aspirations and a cold-blooded professor and administrator could work together in complete harmony on a radically new project. Of course, both in the field and in the University, we had effective organizations back of us. While the primary responsibilities fell upon us, the real success of the undertaking must, of course, be attributed to the effective activities of numerous persons and organizations to which we were duly grateful.

President Macbride appointed a committee of the senate board practically *ex officiis*, with himself as chairman, thus calling all the divisions of the University into co-operation. This constituted the formal organization of procedure but left the actual development of plans largely to me, as collaborator with Mrs. Hillis. In that capacity I had to take the leadership and work out the plan which the committee approved. President Macbride took a very helpful executive attitude, as did his successor, President W. A. Jessup. However, there was no question that the faculty as a whole strongly opposed the movement on the ground that no such thing had been done before, but primarily on the ground that it would result in a diversion of University funds.

I was made to feel that in no unmistakable terms and was branded as more and more visionary as dean of the graduate college in sponsoring this non-academic subject. In this connection we struck a snag when the matter was to be presented to the legislature. We had hoped that the board of education would include the askings — $50,000 — in its regular budget. But both the president and the board objected to that, and we were forced to ask for an independent charter. One fear that we had was that if it were an independent in-

stitution, the legislature might locate it at Des Moines or some other place where no adequate resources were available. Yet as I look back upon the matter in retrospect, I am inclined to think that it was a good thing to charge the appropriation to the Station itself, outside the regular budget, for the formative period, especially since it gave leverage to our appeal to outside foundations for liberal support.

But what was the cause and how was it to be served? Clearly enough the cause was the betterment of the normal child. How was that to be done? The women's answer was always, "The University has guaranteed to formulate the procedure. We have faith in the men in charge of it, and they are convinced that the time has come to organize scientific studies of the normal child." This organization was no small matter because we had no concrete precedent. Our nearest model was the agricultural research stations which were operated under federal patronage.

As a psychologist, I drew up a prospectus which was published as "Plans and Possibilities of a Research Station for the Conservation and Development of the Normal Child."[43] This had six sections: heredity and prenatal care, nutrition of the child, preventive medicine, social surveys and social policies, education and morals, and the services of the extension division. That is a basic document which represents the vision of Mrs. Hillis as interpreted by the University committee. There were several drafts preliminary to this and others followed at the time of the organization of the station, but this bulletin is the keynote which led to the formulation of the charter. It has proved to be a document of historical significance. For the first time it formulated concepts of the scope and general procedure for the scientific study of the normal child on a large scale in a University.

The Iowa Child Welfare Research Station has become the mother institution of agencies of this kind because it sponsored an entirely new approach and emphasized scientific principles which have since then gained approval through the establishment of similar institutions in many parts of this country as well as in foreign countries.

There were four fundamental principles underlying the organization: first, that the Station should be devoted primarily and fundamentally to scientific research; second, that this should center around the normal child as distinguished from the psychological clinics and child welfare service institutions; third, that it should be organized

43 A Child Welfare Research Station, Univ. of Iowa Bull., Aims and Progress of Research, New Series No. 107, 1916, Pp. 18.

largely through the integration of all the divisions of the University that could center research upon the project; and fourth, that it should serve as a central organizing station for child welfare in the state. A word about each of these.

At this time the term "child welfare" meant primarily social service — immediate service in communities with no provision for research. The idea of research was not in favor and was viewed with much skepticism. There was, however, constant reference to the analogy of research on sheep and horses, wheat and corn, forestry and fruit culture at Ames. It was clearly recognized that this was great work and, as science, had done much for the improvement of conditions in Iowa. But one of the distinguished senators said, "When it comes to our children, my good wife and I are willing to trust Mother Nature," to which the senator from Dubuque, who was a splendid worker for the cause, though a cripple, limped up to the speaker, faced him, and thrusting his fist in front of the speaker said, "But you don't trust Mother Nature for your cow or your sow or your mare!" At one hearing another distinguished senator brought in two wheelbarrows loaded with books bearing on child welfare and related subjects and then made a great appeal for practical child welfare; "What we need now is not more books but more service."

The general attitude of disapproval toward our project was not strange; it was the common attitude in regard to placing a child outside of many of the manifestations of natural phenomena. When the bill finally came up, there was much distrust of the provision for research. And in this case, showing how dangerous a little knowledge is, the impression got abroad that research means reinvestigation, and someone moved that the word research be struck from the bill and in lieu thereof the provision be inserted that all the investigations shall be original. I got a long distance call and had to wire back whether or not that provision would be acceptable. I answered in an explanatory message intimating that we could make it work. However, as the bill actually came up for final passage, the term research was retained.

The limitation "normal" child gave us much difficulty. We already had in the University a psychological clinic devoted to research on the abnormal child, and practically all the child welfare agencies in the state were devoted to children who were not normal, or if normal, lived under abnormal conditions. Our slogan was "Better normal children in Iowa." This was attacked on the theory that "if our children are normal, how can we better them?" We answered by pointing to what

Iowa had done for sheep and hogs and wheat and corn. But this restriction of research to the normal child was the key to the whole situation. All the welfare stations throughout the country being essentially clinics were devoting themselves to the suffering child. This feature has been the most difficult for child welfare stations to embrace and many of the institutions which profess this policy as patterned after Iowa still maintain the original clinical point of view fostered by charitable organizations for service.

The provision that the station should be organized as an integral part of the University of Iowa embodied a fundamental issue; namely, that it should serve as a focal center for integrating and encouraging research in all the departments of the University that could contribute to this cause. This principle tapped great resources when the material sciences, the social and medical sciences, psychology, education, and dentistry all turned some research activities in the direction of normal mental human development. If the Station had been located elsewhere, it would have missed the outstanding leadership represented in the strong departments of the University.

Finally it was carefully provided that the energies of the Station, as such, should not be spent for teaching except to the extent that it was necessary to train investigators; and it was also provided that the Station should not conduct the services in child welfare and related subjects in the state, but should serve as a central organizing unit, issuing publications, participating in and organizing committees for the state, and co-ordinating efforts for child welfare in general. Thus, for many years only one undergraduate course in child welfare was permitted, and the staff of the Station was not allowed to go out and render those services which could be conducted by a local community. The wisdom of this provision has been amply demonstrated through the activities of the Station by furnishing leadership and source material from the Station and counting on the local agencies to render the services. Witness the extraordinary output of original literature now flowing in a steady stream from the Station and the absorption of this in homes, schools, and social organizations.

The question of a name was a serious matter. I had formulated the policy of the Station on the theory that it should be analogous and supplementary to eugenics, and therefore proposed the name "euthenics" which would be a perfectly logical name for the discipline and would help center efforts on research rather than on immediate service. However, the committee felt it wiser to put a well-established

name, such as child welfare, into the foreground in order to gain the approval of the people of the state, but give it a new connotation; and this was done. However, I still think that when the work is well established, it would be well to introduce the word "euthenics." As a matter of fact, in adopting the term "child welfare," we gave it an entirely new meaning by adding the word "research" to it.

The theory that the Station would divert University funds did not materialize; on the contrary, the Station drew such large outside funds for the enrichment of research on the campus by implementing the resources in various departments that child welfare was rapidly taken into the bosom of the scientific, educational and social interests of the University as a whole.

I am glad to say that the Station has won very hearty recognition in the state far beyond what we had dared to hope. Scientific investigation leading to the betterment of conditions for the normal child now has general and enthusiastic support in the state and, like the Children's Hospital, it has become a medium for appeal to the state for support in situations which the people understand and appreciate.

Universities in general have been slow in comprehending the real significance of the four radically new principles which we injected into the term "child welfare" at that time; and most of them in attempting to establish stations after our pattern have fallen into the easy ways of compromise by trusting the work to a single organization instead of integrating it into the life stream of the University as a whole. They remain content to render the always welcome service on the meager information at hand rather than to concentrate all their energies upon original research. They have yielded to the demand for immediate service to the suffering child instead of concentrating upon the scientific search for fundamental laws and the means of realization of normal human development. Yet progress toward the development of the science of the normal child is making splendid headway throughout the world, and in the long run the amelioration of suffering children will have profited by concentration upon the science of normal development on the part of institutions basically competent to sponsor such studies. Iowa has contributed significantly to the justification of our prediction that a scientific study of the normal child is feasible and practical and that it is profitable and humane for the state to foster research on the development of its greatest natural resources, the children of Iowa.

The original prospectus, like a fundamental constitution, was in-

tended to be directional for the opening of the work, but it proved to be a comprehensive constitution leading to new and specific forms of implementation. The program involved in our basic principles led to the brave and persistent adherence to scientific principles, the personalization of the workshop, and the extraordinary financial support enjoyed. The countless basic services rendered are fast becoming matters of history, of which Iowa may be justly proud. The organization and conduct of the Station furnish a thrilling example of the joy of pioneering on a new frontier in which all the workers of the Station are sharing.

ASPECTS OF GENETIC PSYCHOLOGY

The work of the Station is generally spoken of as "child development." It covers general approaches to genetic psychology in the broadest sense. As Stoddard has said:

> The staff of the Station, while regarding the child as a psychological whole, does not consider him amorphous. It is feasible to analyze the concept of the whole child for purposes of cross-sectional or longitudinal study, putting him together again, as it were, at appropriate consolidation points.[44]

The central laboratory of the Station is a nursery school having adequate samples of children from two to five years old for experimental purposes. Thus the child as a whole becomes the object of experiment and care. No departmental fences are recognized, resources of the University as a whole are drawn upon, and the various sciences which have a bearing on child life come together in this focal center.

The first director of the Station, Professor Bird T. Baldwin, introduced investigations in physical growth and anthropometry which have continued up to the present time under the able leadership of Professors C. H. McCloy and H. V. Meredith. Baldwin's *Physical Growth of the Child from Birth to Maturity* is a recognized classic.[45] On the basis of material gathered up to date, the Station can now make contributions in answer to certain theoretical and practical questions, such as:

1. What body-build is most efficient in performing necessary physical, physiological and motor acts; that is, viewing the body as a machine, what kind of machine should we try to develop?

44 Stoddard, George D.: The second decade. Univ. of Iowa Stud., Aims and Progress of Research, No. 58, 1939, p. 7.

45 Univ. of Iowa Stud. in Child Welfare, 1, No. 1, 1921.

2. What body-build gives the best insurance against infection and deterioration?
3. What is the relationship between diet and physical growth?
4. What types of body-build appear most effective in terms of biological functioning, as in fertility and longevity?
5. How far can we go through diet, exercise and other environmental controls to develop desirable body-types? What are the limits set by heredity?
6. What are the effects of race mixtures?
7. Do anthropometric factors have significant correlates in mental growth; in child behavior and adjustment?[46]

Parallel to the study of physical growth, and on a much larger scale, has been the study of mental growth in many important aspects, centering especially upon the nature of intelligence, its conditions and the order of development. This has attracted national attention under the leadership of Stoddard, Beth L. Wellman, and H. M. Skeels, together with a number of research associates who have specialized in some aspect of the subject. The child is regarded not as a separate body and mind but as an integrated organism; and not only as an individual, but largely as a social being.

While emphasis throughout is laid upon development of the normal child, the psychiatric background for this is recognized and has been favored by effective co-operation of the staff of the Psychopathic Hospital. A number of joint appointments in psychiatry and child welfare have proved profitable.

Under the direction of Dr. Ruth Updegraff, the preschool is not really a school but a substitute for home life at that age with vast enrichment for training in how to live as an individual and as a social being in health and happiness. The playground and outdoor life are important assets and the day's program is all a part of the play life of the child which tends to develop the more desirable elements in the individual and in the group.

The maintenance and development of the preschool as a model institution of its kind will go down in history as an outstanding contribution from the Station through the crystallizing of the concept of the preschool, the development of types of activities, and the training of pioneer teachers in this new and significantly expanding field.

The Station has been moving distinctly in the direction of social experimentation. As originally planned, various departments in the

46 Stoddard, George D.: The second decade. Univ. of Iowa Stud., Aims and Progress of Research, No. 58, 1939, p. 7.

University have made use of the opportunity for the pursuit of specific researches on the child. Rigorous studies have been conducted in the departments of physiology, hygiene, sanitation, dentistry, and zoology.

Much emphasis has been laid on sustained behavior studies, beginning with the earliest reflexes observed after birth and tracing their development throughout infancy. These have been under the direction of Dr. O. C. Irwin who carries on his work in the obstetrics department of the Children's Hospital.

The nutrition laboratory has been an important unit in the Station under the direction of Dr. Amy L. Daniels, a pioneer in utilizing well babies in long-range biochemical experiments.

Genetic studies in art and music discussed in other chapters have been favored not only by the facilities of the Station in those fields, but by a number of investigations in these fields which have been undertaken by the members of the staff and for experimental developments in the preschool. Since the free hours do not occupy the traditional occupation at this level, art, music and speech in their varied forms tend to become dominant in child life and afford a valuable approach for the all-round development of the child through drawing, painting, modeling, music and dancing.

Through the generous long-time support of the Laura Spelman Rockefeller Memorial, provision has been made for educational and social work in selected communities, aiming to identify and analyze typical home and other environmental situations, which are more or less under the control of parents in rearing their children. This division of the research work has come to be recognized as "parent education" under the direction of Dr. Ralph H. Ojemann, with a staff of associates. This has proved a happy approach both from the scientific point of view and evaluation of knowledge and service. It has aided in the development of field service units including recent comprehensive programs by radio. Extensive field studies have been made by psychologists, psychiatrists, and hygienists for the analysis of the conditions for child life in distinctive types of communities; such as, a large city, a progressive rural district, and a backward rural district.*

Such are some of the specific lines of approach in the study of the child under the impetus and with the very unusual facilities of the Station. The central theme has been the *development of the normal child*. The majority of the investigations and resulting publications

* The recent addition of Professor Kurt Lewin to the staff has led to the introduction of significant new types of problems and to the organization of a group of advanced workers in co-operation with him in the application of principles of topology in social psychology.

have been within the area more specifically designated as genetic psychology. It has been the happy lot of Professor Wellman to guide and integrate investigations, especially on the nature and development of intelligence.

I cannot here begin to give credit to the large number of mature and independent scholars who have worked in the Station, making independent contributions, or to the large number of these who are now stationed throughout the country as directors of research within this field. After all, the most profitable output from the Station is the trained workers who will carry on.

The scope of publication is indicated in the following table, based on the cumulative record to June 30, 1940.

Station Publications

(includes Station series and outside channels)

	Number
General development and methods of study	35
Nutrition	68
Physical growth and measurement	88
Child psychology; child behavior	275
Preschool education; education	117
Parent education	135
Character education and mental hygiene	47
Studies in allied fields, such as physiology, dentistry, speech and art	53
Reviews and abstracts	42
Popular bulletins; popular articles	150
Total	1,010

Distribution of Materials Issued Directly by the Station

Technical monographs	45,256
Popular bulletins and pamphlets	958,738
Standards, test materials	1,534,452
Total	2,538,446

Since the Station operates entirely at the graduate level for training specialists in child development, it is significant that up to January, 1941 there have been 66 doctorates and 116 master's degrees awarded in the Station.

It is needless to say that the department of psychology has been given a unique stronghold for genetic psychology through the virtual presence of psychologists on the staff who operate in the Station from

various points of view and in intimate co-operation with the department of psychology as a whole.

Thus in terms of facilities offered, the building of research and service staffs, adequate financial support, and the good will of the University as a whole, the Station presents formidable contributions to genetic psychology as a study of the total personality of the integrated child in relation to the total situation. Its field is genetic psychobiology.

It is a long leap from Stanley Hall's bold venture in child study to this up-to-date concept of technical approaches to child study. The first time I heard Stanley Hall, he was introduced as the greatest authority in the world on the study of the child. He acknowledged this introduction, saying,

> "The chairman is probably right. I am the greatest authority on the study of the child. But the pity of it is that I am president of a university, I am the writer of books, I am the editor of magazines, I am a popular lecturer, I have been brought up as a professor, and I am supposed to be the sponsor for all types of research in the university. That is the pity of the situation."

The Clark University type of child-study which held an early sway faded out more or less universally in the educational mind, but Hall had the comprehensive and inspiring point of view which is today, in its advanced forms, the key to the situation.

To Dean Stoddard, who has been and is still the moving spirit in this program, applied genetic psychology is under great obligation. He is the Stanley Hall of this new epoch of *Child Study* based on farsighted and critical principles and a genuine sense of its value for the betterment of the child, not only in Iowa but throughout the cultural world.

Chapter X

PSYCHOLOGY IN EDUCATION

"BRASS INSTRUMENTS" IN EDUCATIONAL PSYCHOLOGY

Following our definite policy of entering into allied fields wherever possible, by means of technical laboratory measurement, and of being alert to all sorts of applications that might come out of a technical experiment in pure psychology, notable contributions to educational principles have been made. In fact, one of the definite objectives of the laboratory has been to inject rigid laboratory procedure as a fundamental requirement for a science in the division of educational psychology. It would be interesting to review all the publications of the laboratory for the last forty years and list such contributions to education. Many have been avowedly of an educational character; but in the majority of our researches, the educational significance has been a by-product of the establishment of psychological facts and principles.

Among the general principles thus derived are the following: (1) The extent and significance of individual differences in native abilities and the necessity for ways and means of taking these into account in educational procedures; as, for example, in the variety of talents, subnormal and super-normal deviants, and various degrees of common delinquencies and defects of children. (2) Both animal and human psychology as pure science carry wide implications for techniques in learning. (3) In many channels the laboratory provides specific apparatus and techniques for training purposes. In short, educational psychology in the laboratory limits itself to laboratory procedures; whereas, educational psychology in the practical field flows out of general educational theory and operations and experiments in the actual schoolroom.

Where individual treatment is necessary, the college of education and the Psychopathic Hospital have delegated the responsibility for re-education and adjustment of educationally maladjusted children to the psychological clinic. In recent years the largest number of cases has been handled in speech correction, and cases from the most ex-

treme stutterers and spastics down to a variety of inceptive speech defects have been treated.

Next in importance has been the reading clinic. Through co-operation with the Psychopathic Hospital and the college of education, the training of skilled psychologists has become a distinguished feature of the clinic.

In the psychology of music emanating from the laboratory the most widespread interest has pertained to interests in musical education built around the theory of the nature and the means of development of musical talent. This has not been limited to the exceptionally talented but pertains to all levels of musicality. Definite procedures developed in the laboratory are being inaugurated in the music schools and especially in the public schools.

From the Iowa psychology of graphic and plastic arts there has emanated a considerable number of procedures for selection, analysis, guidance, and intensive training through the elementary courses in art.

In the department of speech a new type of comprehensive course in phonetics has grown out of the laboratory researches in that field, and manuals for general training in artistic and effective speech have been developed.

In all these educational disciplines emanating from the laboratory there is a unique element of stability and permanence which we may call a frame of reference, the essential part of which is the organization of the training of the child on the basis of preliminary analysis of his needs, competence, and level of achievement, together with an attempt to fractionate the learning process in such a way that the learner always has a specific objective and the means for knowing and evaluating the nature and degree of progress made in the training. Techniques of the classroom do and should shift with personalities and the countless changes in educational progress; but this frame of reference which rests upon laboratory measurement, when competently elaborated and established, is destined to be of fairly permanent character. With that as an objective, scientific research in educational psychology has not only a starting point but also a "blue print" for endless educational research.

The holding of joint appointments by psychologists in the college of education has been of vital importance in eliminating the traditional conflicts between departments and in the functional transfer of psychology into the organization and teaching of educational psychology.

For one thing, our teachers of education do not teach elementary psychology in courses in education, since it has always been a prerequisite to such courses. A sympathetic recognition of this fact has been very wholesome as educational psychology is not taught until the student has some knowledge of psychology and has acquired a psychological attitude.*

PSYCHOLOGICAL THEORY OF EDUCATION

From technical approaches such as those just mentioned and from my actual experience as a teacher, there have grown up a number of definite theories in the psychology of education. To put these theories into practice and to assemble them in a cumulative series leading to a general theory, I have followed the novel plan of dealing with one general issue at a time, expressing each in the form of a series of open letters. Among these are the five letters contained in my *Preview to College and Life* [47] and my open letters to the professor, the college dean, the junior college dean, and the unpublished one to the univer-

* I must here touch upon a movement which has affected university education on a national scale; namely, the spread of a "Teachers College" pattern into the organization of state universities and independent colleges. In the large state universities in which this type of organization has become dominant, psychology was largely taken over by education and made a service unit. Psychology has often been promoted on a large scale in this matter but has always tended to lose its identity, choice of leadership, and initiative. The University of Iowa perhaps holds the most consistent record for resistance in opposition to this type of organization, our policy often being spoken of as the Iowa Plan.

Psychology has always stood on its own feet, had every encouragement for its development without any sense of subordination, and has therefore had the opportunity of adhering to its scientific techniques, utilizing laboratory facilities, and directing research interests along lines which are the natural outgrowth of the fundamental work done in the laboratory. Indeed, research on educational problems was well on its way in the laboratory before the college of education had become interested in the experimental approach. This is quite in contrast to what is seen in several universities and colleges where psychology is clearly dominated by the practical interests of education. This status of psychology and education in Iowa was made possible by reciprocal and sympathetic willingness to co-operate.

The teacher-college type of organization in colleges and universities has resulted in the tendency to "separate education from learning" in that a four-year undergraduate course in education is set up with rigorous professional requirements, supposedly to cater to the public schools. In some institutions, there are more students registered in the college of education than in the college of arts and science; but, as a rule, the scholarly professors are in arts and science. It is to the great credit of the college of education in Iowa that professional training for education has been largely within the graduate area and that only a minimum requirement for certification has operated in the college of arts and science; and that during the last two years.

A sequel associated with this type of organization is that, instead of usurping the right to teach how to teach every subject, our college of education has established co-operative relationship with every department so that a course in how to teach, for example, physics or Latin, is taught by a person who is technically recognized and has a status in the department of his specialization and is also qualified from the educational point of view. This division of labor has resulted in great vitalization of the motivation of undergraduates toward the interests of teaching and has laid sound foundations for graduate work.

47 Univ. of Iowa Stud., Aims and Progress of Research, No. 55, 1938.

sity president. I have had the satisfaction of seeing some of these letters distributed in large editions and actually put into practice on a surprisingly large scale. While I have not attempted a general philosophy of education, the underlying principles of such a philosophy may well be gathered through the cumulative series of those open letters. I take particular satisfaction in saying that my interest has not been primarily to build up a theory but to put such fragments of theory as I have into actual practice.

THE GIFTED STUDENT PROJECT

The Gifted Student Project in the National Research Council must find a place in this series because it was distinctly and essentially an Iowa feature, in that I formulated the program and got its approval in the Council, and Professor G. W. Stewart, also of Iowa, went out to colleges and universities on the mission the first year while I served as representative for the remaining five years of the project.*

During the war I served as chairman of the committee for the selection of college seniors who could be trained most effectively in a short time for technical services. We had in operation a plan by which college faculties were asked to select from their senior classes ten per cent of the students who were most promising in this respect. This met with such favorable response and seemed to be so profitable that at the close of the war we found general support for a project to adapt and continue some plan of selecting and encouraging gifted students for peace-time purposes. An adequate grant for the purpose was received from a foundation, and I was made chairman of this peace-time program partly because of having originated the idea and partly because I was chairman of the Division of Anthropology and Psychology and a member of the Division of Educational Relations in the National Research Council.

During that year in Washington there was some dissension in the Council concerning the way in which it should make its contacts with the country at large. The previous year the Division of Educational Relations, of which Kellog was chairman, had sent out visitors from the Council to take cognizance of the resources and other facilities for the encouragement of graduate work in the universities and they had

* It was notable that initiative for this movement came out of the Middle West, which on issues of this kind, was much more responsive and far in advance of the older and crystallized universities. Iowa therefore became a sort of symbol of the conservative progressive education coming to the front in the Middle West for a recognition of the individual in education.

piled up elaborate stacks of reports. I had opposed this plan for two reasons: one was that universities would not welcome a man who came in to inspect them and extract reports; and the other was my prediction that those reports would never be used in any effective manner. Both contentions were, of course, true. So the Gifted Student Project came from a few of us who represented the opposite approach; namely, that of sending out a good-will messenger whose aim was to bring something from the Council to the universities or colleges instead of going out to investigate them.

To accomplish this, it was necessary to have a worth-while message which would appeal to colleges and universities. This took the form of a series of suggestions which might be considered in the interest of adequate recognition of the needs of gifted students. The formulation of these and their revision from time to time was left to the Council representative. During the first year Professor Stewart concentrated upon the following issues:

> Faculties should give as much attention to gifted students as to poor students. This should take the form of individual encouragement rather than teaching. Emphasis should be laid upon quality rather than quantity of work. Various means, such as honors courses, the beginning of research, public recognition, flexible curricula, and companionship with scholars, were reviewed.

In preparation for my part of the work I approached the problem from the point of view of educational psychology and listed over a hundred specific things which might be significant. In the actual fieldwork I boiled this list down to fourteen; and as a sort of stunt throughout my travels, I kept my kit of projects limited to fourteen on the analogy of Wilson's fourteen points which were in high favor at that time. These changed from time to time as my experience broadened and I gained insight into actual needs and conditions of the country through the vigorous response given by each institution in the discussion of the needs of gifted students. A list of these as they stood toward the end of the project is given in my *Learning and Living in College*,[48] which is essentially a report on the Gifted Student Project.

The procedure in the actual operation of the project was rather formal. An invitation was sent out by the secretary of the National Research Council, which was recognized as a working unit of the National Academy of Science, asking the president of a university if he would welcome a visitor from the Council for conferences on the

48 Iowa City: The University Press, 1927, Vol. 2, Pp. 124.

Gifted Student Project. Upon a favorable response to such an invitation, an itinerary was made out covering a period of from two to six weeks.

The plan met with extraordinarily favorable response so that the day of the visit was made a campus feature in the interest of gifted students and took a variety of forms for meetings of faculties and students. The result was that a day's work turned out to be unreasonably strenuous.*

Important business has been done in a day by good-will messengers on a campus, but few educational issues have drawn so vigorous response from faculties as did the appeal for gifted students.** Although the topic for each conference was different throughout the day, all dealt with the same fundamental theme which had been my principal interest during my year in the Council and the year before that, during which time the project was conceived and discussed among the scientists and educators. The psychological theory underlying this

* I shall never forget my first day out. It was in Bloomington, Indiana. Every hour of the day and evening had been scheduled in advance. I arrived on the morning train and was met at the station by a professor of psychology who took me to a psychology breakfast which was continued as a conference until ten o'clock, at which time I met with the president and a group selected by him as interested in personnel service. This conference lasted until twelve o'clock. At that hour the president gave a luncheon for the deans and other administrative officers and the conference continued until two o'clock. Then there were a number of individual interviews, and at three o'clock I was to address the faculties. I think this included all the faculties except law and medicine. That meeting continued for more than two hours, and at six o'clock there was an all-university dinner announced as given "in the cause of recognizing gifted students throughout the university." I had been worked into a state of tension in which one feels that he has a grasp on the situation and is enthusiastic about going on but does not realize the limits of his energies. Seated at the dinner table next to the president, I confided in him that my soup plate seemed to be rocking, which probably was a warning that it would be better for me to rest than to eat at that ime. So I was taken to a side room and fell into a profound sleep for an hour which restored my energies so that at the close of the meal I reappeared and was introduced by the toastmaster as the speaker of the evening. I spoke for about twenty minutes, challenging discussion which grew so intense and lively that it continued until eleven o'clock, and during these hours I stood single-handed, responding to rapid-fire questions from all quarters. I then took the night train and appeared at Purdue to go through a similar program.

This first-day's program was in some respects extreme, although on several occasions it was fully duplicated; as, for example, in the University of Washington, where on one day I addressed four faculties and attended and spoke in turn at a breakfast, luncheon and dinner, in addition to a number of individual conferences with the faculty and students. I mention this in part to show that the project attracted general interest and met with great favor on the part of colleges and universities everywhere, and that, in each case, the entire campus was responsive to the issue.

** One feature, which developed much interest, originated by Stewart and later continued by me, was the plan of allowing each department to select one or more of its most promising students to meet with the visitors for discussion and counsel. This honored a significant group of people who were perhaps brought together for the purpose for the first time, and gave the visitors an opportunity to answer questions centering on the live issues in the minds of these selected groups. It was surprising to see how many attitudes could be changed at a conference of this kind on a comparatively short notice.

aspect of education had been vitalized through my experiences as dean of the graduate college in the University of Iowa; but the whole project was an outgrowth of my laboratory experience in the measurement of individual differences.

As I look back upon it now, one of my personal traits cut an important figure here; that was my extrovert tendency to thrust myself into a frontal attack, not stopping to count noses but forging ahead on the objective in hand. This attitude, of course, drew fire and that was what livened up the situation and put enthusiasm into the issue on the campus.

One of the by-products of this Gifted Student Project was the adoption of my *Open Letter to a College Senior* as an annual message to every senior graduating from a liberal arts college. This letter was circulated for a number of years by the Council and at other times by other national agencies, while several universities and colleges printed their own editions from time to time, so that this bulletin has been circulated for twenty years in some form or other and has served a unique purpose.

Another by-product of this project was the building of a series of bulletins, one for each department of science interested in research, analyzing the needs, ways and means, obligations and probable professional outlook for students desiring to specialize in a given field. I organized and edited the first volume of these. They were issued for several years by the Council, sometimes the same bulletins being printed from year to year and at other times one written for each year by a different representative. These were made available to all college administrators and to students who might write for them. They proved a very valuable guide.

It would be interesting to know how many important resolutions of faculties followed immediately upon the messages presented by Stewart and myself. The factors proved timely in the launching of the movement for the recognition of individual differences. At Williams and at Dartmouth I came in at the height of reorganization movements and several of the issues which I presented fitted effectively into the program for the reorganization of the curriculum.

It was indeed very gratifying to have the privilege of representing the highest national organization of scientific men on this issue, conveying good-will greetings and policies with utmost freedom. Many of the measures which we advocated were revolutionary from the point of view of traditional curriculum-making, but we had absolutely

free hands, free speech, and the privilege of walking in where local administrations often feared to tread.

It was gratifying to have the annual approval of our procedure and the results of the project in the National Research Council. There was no difficulty in financing it. However, neither Stewart nor I felt that we could continue work on this project beyond the sixth year. A proposal was made to make it a full-time job for a period of years, and this could easily have been financed; but there did not appear to be any qualified representative willing to make the sacrifice. So the project came to a natural end and perhaps reasonably so; because, in large part, it had served its purpose as a psychological move in the after-war period, and faculties throughout the country had become active and aggressive on this issue on their own initiative.

AN ACADEMIC "BRAIN DERBY"

In my development of the Gifted Student Project, the center of emphasis lay, of course, in the discovery and motivation of the gifted student; and in my *Learning and Living in College* I outlined various ways of serving this purpose. The Harvard chapter of Phi Beta Kappa was at that time concerned about the ways and means of raising qualifications for membership in this honor society and particularly in the possibility of discovering suitable material early, possibly at or soon after admission to college, in order that promising students might be identified and guided in the courses of study leading up to honors. They asked me if I could make a suggestion for some procedure which might be sponsored by this society on a national scale.

In response to this request I drew up in skeletal form a plan for competitive examinations and later published it under the title "Intercollegiate Academic Contests." [49]

This particular procedure was an adaptation of a plan I had developed for academic contests among high school students under a state organization, practically the same system which was put into operation by the college of education for the State of Iowa in 1928.

The phenomenal development of the so-called Iowa brain derby under sound and efficient leadership of Professor Lindquist is a matter of record. A majority of the high schools in Iowa are under its influence throughout the year and are represented in the final contest at the University in the spring. Two features are outstanding: first, the schools are being highly motivated for superior achievement in

49 School & Soc., July 28, 1928.

the pursuit of the academic subjects in preparation for the local examination given annually, and in this there is a wholesome breaking up of the tendency to be satisfied with a "union scale" of performance so that each individual is encouraged to compete at his natural level; and second, through these examinations, a thousand or more of the most superior high school students in the state come together at the University for final tests and for a grand celebration of their achievements. This is a clean sport, vigorous as an athletic contest, with far-reaching practical results.

Parallel with this academic meet and operating on the same principles, the University now has corresponding contests on an organized state plan in music. This has vastly improved the status of musical organizations in the high schools, has given an opportunity for progressive selection and differentiation of musical abilities and achievements, and has effectively motivated musically gifted students in the serious pursuit of their subjects.*

The same procedure operates in the field of speech, where a state program is well organized for the motivation of speech instruction in the schools; talent is discovered and encouraged, and in the final contest the outstanding talent in the state is given recognition and encouragement.

Likewise, in the field of graphic and plastic arts, a similar type of contest is being developed with very great promise.

It is interesting to trace the origin of these very significant practical movements to the scientific study of individual differences in the respective subjects concerned. Much of this interest can, of course, be traced to the impetus given in the psychological laboratory for the development of precise knowledge of individual differences and principles of selection and motivation.**

* From students discovered by this dragnet, an orchestra and a chorus are built up for intensive training in the University campus during the summer sessions. In the summer of 1940, this orchestra gave a notable symphony orchestra performance at the end of the first week. Every participant was highly talented.

** Iowa has held a notable lead in the development of state contests in academic subjects; such as, the general academic contest and contests in music, speech, graphic and plastic arts, and dramatics. Each year some improvement is made, and there are some fundamental changes taking place in regard to the conceptions of purpose and general plan of meetings. Thus, the academic brain derby will be discontinued in its present form and will be replaced on a larger scale by a program of achievement testing in the schools with emphasis upon both aptitude and achievement. The state music festival proved too large and was therefore divided into regional units. The unit which meets at the University has become a conference clinic with extensive opportunities for performance. Similar changes will, of necessity, have to take place in the other state contests. The general trend is to stress the element of competition less and to develop facilities for diagnosis and motivation in the individual skill.

In order to facilitate the application of educational implications of laboratory experiments, I have published a series of thirty articles during the last four years in the *Music Educators Journal*, under the heading "The Psychology of Music." In these articles I have described a laboratory experiment in high relief and have then pointed out the educational implications for musical education, stressing in particular the possibility of trying out the recommendations made in the actual teaching of music.

My *Psychology of Musical Talent* [50] was, of course, essentially pedagogical in its aim. My *Psychology of Music* [51] has four chapters dealing especially with psychological methods of meeting teaching situations. In my *Why We Love Music*,[52] Chapter II, "Music Before Six" and Chapter III, "Music Between the Ages of Six and Ten" present my views on teaching music to children.

THE TEACHING OF RELIGION IN A STATE UNIVERSITY

At the opening of the present century, the people of Iowa as a class had a normal and stabilized but highly denominational religion. They fostered the denominational college and frequently branded the State University as a godless institution. Having lived in the atmosphere of the philosophy and psychology of religion at Yale University, I soon came to the conclusion that the University was neglecting something; and I began to look at the local situation in a practical way, as head of the department of philosophy and psychology and dean of the graduate college.

In my address as retiring president of the Midwestern Philosophical Association in 1908, I took as my subject "Play in Religion," and attempted to show by psychological analysis that religion is a natural and essential element in mental development and that it takes the form of self-expression for the joy of expression, as in play. Professor Starbuck, already well-known as an authority on the psychology of religion, introduced courses on that subject in the department. At that time it was generally conceded throughout the country that a state university could not offer formal courses in religion. In the faculty and in the student body as a whole, there was a fine and positive expression of the religious life; but this was viewed as something outside of the University's sphere of influence. In the popular mind, religion stood out as something quite apart from learning.

50 New York: Silver Burdett, 1919.
51 New York: McGraw-Hill, 1938.
52 Philadelphia: Oliver Ditson, 1941.

To meet the clearly felt needs and at the same time avoid the limitations put upon the state supported institution, we conceived the idea of allowing certain approved local ministers to offer elective courses for a very limited amount of credit in the academic program. This offering was enriched by listing with the religious courses certain academic courses; such as, the Bible as literature, the history of the reformation, and the philosophy of religion. This policy was gradually sanctioned by the University authorities and was in operation about fifteen years.

The significant thing about this movement was that it paved the way for the establishment of the now well known Iowa School of Religion, which carries the same principle of organization to a higher and more formal level in that Protestants, Catholics, and Jews are united in a school maintained by the churches or private benevolences but sanctioned academically as a department in the University and operated on the University grounds. Thus, in a single generation, the conception of the teaching of religion in a state university went through a natural but very rapid development from the traditional fearing and ignoring of the problem to a well organized policy and practice of religious education with a fully recognized place in the curriculum. Such a bold venture could come about only by a timely development of broadmindedness in religious thinking in harmony with social and industrial evolution of the day and the vitalizing of the academic curricula by the development of a functional view of life as a whole. This School of Religion was organized as a national experiment and has been influential in the development of similar movements in other state institutions.

During this period of chastening of denominationalism and the incoming of a co-operative spirit in the first decade of the present century, I made what I now regard as a small, yet significant job analysis of religious co-operation in Iowa City as a university town. Under the leadership of the ministerial union of the city, six Protestant churches seriously considered the following plan:

Each church was to maintain its denominational identity, the morning service, Sunday school, and the young people's groups. But for Sunday evening an all-city co-operative program was set up. In general it recognized six fields of activity for Sunday evening; namely, evangelistic services; church extension; children's programs; music, dramatic reading and pictures; lectures; and conferences. These were paired to alternate so that each Sunday evening three programs would

operate, one in each of two churches and one on the University campus. Thus, in general, there would be a program of distinguished sermons or lectures sponsored jointly by the churches and the University, the program for young people dominated largely by interests in music, dramatic arts and moving pictures, and the children's program featured by children's activities as opposed to formal instruction.

This proposal was laid before the six churches and a vote was taken which resulted in three churches for and three against the plan. However, at that point it was dropped because it was felt that it could not be successful unless it had fairly unanimous support. But even support of half of the community for such an advanced program was rather remarkable at that time. I still feel that in principle the program is sound; and if religious leaders of town and gown in Iowa City today attempted to set up such a program, it would carry and might well become an epochal event in applied religious education.

We may recognize three objectives for the development of religious education in a community of this kind: first, academic instruction in religion; second, the integration of students' religious activities and organizations under the guidance of the School of Religion; and third, the reorganization of church activities in harmony with social and religious progress and on the basis of a sound psychology of education. The first two of these objectives have been achieved to some extent on the campus. The third may be the next logical step, and in this the School of Religion may take a guiding hand but will work primarily through the presence of faculty and student participation in their respective local churches. This will be religious education applied. It will make the churches of the university town a model experimental unit in the advancement of religious life.

Among the basic principles involved in such a movement are the following:

1. In all educational activities we should recognize the principle of individual differences which is perhaps more deep-rooted and significant in religion than in any other field of learning, adjustment, or co-operative activity. This plan is opposed to the much agitated theory of organic church union which rests on the assumption that all the people of a community should worship in the same church and in the same manner. By this plan the principle of individual differences is implemented so as to conform fully with current psychological theory.

2. As the introduction of experiment has vitalized science, so the

introduction of worship and learning through self-expression has vitalized religion. By this plan, the religious activity of the community takes the form of dramatic exhibition of progress in religious thought, the vitalizing of religious values, the utilizing of skills in achievement, and the general principle of learning by doing, each individual being given his choice of avenues for self-expression. It recognizes the fact that personal development, whether in learning or skills, always comes more effectively through self-expression than through teaching.

3. The implantation of religion is most effective in childhood and early youth. Yet religious church life has been built dominantly on the adult pattern, assuming that the adults would cater to youth and provide religion for the children. My plan recognizes individual interests and natural levels of achievement. It casts religious activities in the form of conference, play, contest, and the spirit of joy in achievement. Children have Sunday school activities built on up-to-date educational theory. Youth can conduct their own programs through the means and in the interests which make the largest appeal to them. The long-faced pietists can have their cravings satisfied except in one point; namely, that they can not force their way of thinking upon the rest of the community, and advanced religious thought will be promoted on the principle of the forum.

4. The prevailing development of church organization throughout the state must be respected and encouraged. The church maintains its state affiliation and local organization and features essential to the maintence of these. Students may be trained for active leadership in their home churches and communities. At the time this plan was first proposed, the evening service was more prominent than the morning service. Since then, the evening service has dropped out without the logical development of a substitute. Today, this plan might serve this purpose.

5. Art should hold a large part in religion; worship should be beautiful. The chief media for children and youth here provided for are music, dramatics, and pictures, all to be rendered in a religious atmosphere, cultivating the love of God and the love of man reverently.

6. A program of this kind should prepare for and cultivate a spirit of social awakening, which in modern times takes the place of revivals and religious stagnation, keeping abreast with the times in the spirit of freedom and the desire for religious growth.

PHYSICAL EDUCATION

When it became apparent that the policy adopted for the organization of research work in speech was an assured success and clearly indicated a type of approach to other new fields, President Jessup called me in and said, "I will give you ten years to develop *bona fide* graduate work in physical education." Everybody knows how barren physical education was from the scientific and academic points of view at that time in graduate work throughout the country. The challenge was accepted and, as usual, the success of the venture depended on the discovery and encouragement of a more or less genius-like personality for leadership in that field to put the adopted project into effect.

Let us recall that the underlying principle was that the candidate for the doctorate in physical education must have foundational work in the underlying sciences; such as, physiology, anatomy, psychology, mathematics, and education; that all this instruction shall be obtained from the specialized departments while maintaining a core unit in the general history and theory of physical education; and that the doctoral dissertation may be written under the direction of specialists in any of these underlying sciences, in which the contributions to the theory and practice of physical education may be found. It was assumed that desirable proficiency in floorwork and management of practical work in physical training had been covered so that all the researches leading to the doctorate would center around scientific laboratory or field studies. We were not fortunate in our first choice of a professor to develop this program. Although proficient as a trainer and having a doctor's degree in physical education, he failed to show any aptitude for directing research or for integrating a co-operative program with other departments, so we marked time for three years.

At the end of that time, Professor McCloy had come into the Child Welfare Station as a specialist in anthropometry. He was thoroughly conversant with the practical work in physical education, but his interests lay entirely in scientific approaches. He was given a joint appointment in physical education and his time was reserved exclusively for research with the privilege of utilizing any facilities available in the University. He immediately drew around him a new type of advanced student of physical education and opened the way for the granting of the doctorate for research within that field.

As director of research, McCloy has set a remarkable record in his own output and in the contributions of his research students. He teaches a course in the psychology of physical education. I think it

may be safely said that in this respect the Iowa department of physical education has no close competitor among universities of the country. It is surprising to see what extraordinary facilities for the development of this work were lying idle in the medical school, in child welfare, in psychology, and especially in physiology. The connection of psychology with this work lies in the fact that most of the researches are extensions from the techniques standardized in psychological experimentation and statistics.

THE TEACHING OF PSYCHOLOGY

From the very first, the department of psychology at Iowa has recognized its responsibility for applying psychology to the art of teaching psychology. We have accepted seriously the challenge: Thou that teachest others, teachest thou thyself? We have enjoyed absolute freedom and much encouragement for experimentation in this field and have aimed to keep in the front line of experimentation as facilities and methods of teaching have developed. Throughout the period under discussion, experimentation has been continued in three fields of the teaching of psychology: namely, the elementary course, the laboratory course, and first-hand experiments. I shall give a brief account of each of these in so far as they deal with methods of teaching in general and with teaching of psychology in particular.

The Elementary Course

The principal steps to be considered in relation to the elementary course are: (a) the introduction of the class experiment; (b) the orientation lecture; (c) sectioning on the basis of ability; and (d) the project method.

(a) *The Class Experiment.* During the first decade I developed a system of class experiments designed to take the place of the traditional lecture. The committee on the teaching of the elementary course, of which I was chairman in the American Psychological Association, approved this plan unanimously and published an account of it.[53]

In accordance with the recommendations of the committee, the elementary course should consist of one class experiment, one orientation lecture, and one discussion group in small units sectioned on the basis of ability with careful provision for promotion and demotion from time to time as the student develops.

53 General report on the teaching of the elementary course in psychology: Recommendations. Psychol. Monog., 1909-1910, 12, No. 5, 80-91.

The directions for class experiments were published in the form of a manual, *Elementary Experiments in Psychology*,[54] which for a period of about twenty years outsold all the other experimental manuals together and proved of great value especially in small institutions which could not offer any laboratory course. A complete revision of that manual was published in 1935.[55]

The class experiment was designed for two reasons: first, a positive conviction that no respectable science can, in the long run, ignore systematic experimentation as the method of teaching the first course; and second, the desire to avoid taking the elementary student into the laboratory for the manipulation of apparatus before he has gained an orientation with reference to the psychological problem.

I have observed in universities which have well-equipped laboratories that if the elementary student is taken into the laboratory for individual experiments in the first course, he fails to see the psychological problem and at best learns to manipulate instruments which are usually a bugbear to him. He has no orientation for perspective and becomes distinctly instrument-minded. The experimenter can make of the class experiment a finished work of art, both as to the presentation of stimuli and the organization of the student's responses, in such a way that he need not apologize for repeating it in exactly the same way from section to section and from year to year except in so far as he can add finishing touches or introduce new experiments to bring the course up to date.

Thus, for the teacher, the class experiment has the advantage of calling for only one set of apparatus, and this is especially designed for the classroom. Only one member of the staff needs to prepare the experiment. It reduces enormously the amount of time taken for the direction of experiments and the size of equipment, and therefore the cost of instruction also decreases.

Since the procedure is highly standardized for the student, a class experiment has the advantage of giving him a whole hour period of participation in an actual experiment on one specific topic, as if he and the instructor were the only persons present in the room regardless of the size of the class, where all his energies are directed to the development of insight and precision in response to the situation set by the experimenter. He is very much better off from every point of view than he would be if he were thrown upon his own resources in

54 Seashore, Carl E.: New York: Henry Holt and Company, 1908, Pp. 218.

55 Seashore, Robert H. and Seashore, Carl E.: Manual of elementary experiments in psychology. New York: Henry Holt and Company, 1935, Pp. 219.

the individual laboratory or were taught the facts without experiment. As he organizes his own record in review, he feels that he really understood what he was doing and finds that it conveys an organized body of facts on a specific psychological problem. The instruments used may be simple or complicated, but that is none of his concern at this stage since the exercise is designed as a training in exact observation in the controlled situation where the instructor takes the full responsibility for the control and the object is not primarily to teach the operation of instruments.

The manual for the elementary experiments was so designed, that in the absence of a laboratory, every experiment could be performed without recourse to the equipment of a psychological laboratory. As Munsterberg said, in response to an inquiry about the equipment of a psychological laboratory in a small college, "What you need is some paper, pins and string and an instructor who knows his subject." For two decades, thousands of students in small colleges were enabled to perform an experiment a week relatively without equipment.

On the other hand, in laboratories such as ours, equipped with a special series of instruments designed for the purpose, the manual, which in this case was a workbook, could be followed by the student and save the expense of mimeographing and printing the directions. In this form the class experiment was conducted once a week throughout the year for three decades; that is, up to the period of my retirement from the headship of the department, and I think it was generally recognized on the campus as an outstanding example of the scientific teaching of concrete facts and the installation of skills in psychological observation.

(b) *The Orientation Lecture.* The orientation lecture, given once a week, was designed as a reaction against the so-called informational lecture which is intended as a substitute for reading. In Iowa we have always required heavy reading assignments in the elementary course, the reading being supervised in conference sections. The students have been required to buy two or three textbooks, and ample sets of reference books have been maintained in the reference section of the departmental library. Repetition of textbook material has been avoided in the lecture. The orientation lecture has therefore been used to organize the findings of the assigned readings and integrate the findings of the experiments with them. Ordinarily examinations have been restricted to the assigned readings as the character of the work done in the experimental unit is on record for each day, and

the orientation lecture has been used mainly to create an atmosphere and point of view.

(c) *Sectioning on the Basis of Ability.* The quiz section which occupied the third day of the week in the three-hour course throughout the year has been vitalized by the operation of the principle of sectioning on the basis of ability described in Chapter VII. This feature of keeping each student busy at his natural level of successful achievement has been a central problem of all of our teaching of psychology, thus avoiding the teaching of what is already known by superior students or presenting material which is over the heads of the inferior students in the class. This made the discussion group a real challenge to matched wits and a systematic aid to those who had common difficulties in making the grade. Psychologists, in general, and educators, in particular, have disgraced themselves more by ignoring the fact of individual differences, which they so loudly proclaim, than by anything else in teaching. Since we always had large classes, it was easy to avoid conflicts in registration and possible to select instructors best qualified for the skillful handling of poor, average, and superior students, respectively.

(d) *The Project Room.* Perhaps our most outstanding contribution to the teaching of the elementary course was the introduction of the project method described in my *Learning and Living in College.*[56] For us, the sectioning on the basis of ability had been an undoubted success, but we saw the possibility of carrying it one step further; namely, to provide for entirely independent work on the part of each student for two two-hour periods a week in a three-hour course.

President Jessup was very much interested in the project method which we had developed and gave us free hands to design and equip a room in which each individual student should have a library desk and free and easy access to a selected library appropriate to the topic under discussion. This gave us room 301 in University Hall.* No other elementary course in the country has matched the equipment of this room on so large a scale.

This room was supplied with one hundred individual library desks so that sections of one hundred could be carried in each period. Along the walls were book shelves containing selected books, both standard texts and sets of supplementary books, so that each student could help himself to any book he wanted. The work of the year was divided

56 Univ. of Iowa Stud., Aims and Progress of Research, No. 21, 1927, 75-87.

* See Figure 7, Chapter II.

into monthly units, each month terminating with an examination, of which one hour was objective and one hour was of the essay type, a check list of the questions having been given out in advance.[57] A *Manual of Instructions* was printed annually with references for each month. The class met for two two-hour periods in the project room and met in three large sections for a class experiment or for an hour's orientation. One hour a week the class was expected to perform an experiment in accordance with the *Manual* or other guide and, for the remaining three hours in the room, to read on topics assigned and outlined. No lecturing or general discussion was allowed in the room, although there were usually two instructors present, moving about in the group, giving their full time to individual consultations. As many as six hundred students were handled by this plan in units of one hundred. When there was a demand for it, weekly volunteer discussion groups were maintained; one for the superior students who were capable of carrying on advanced discussion, and the other for students who needed specific help. But due to the opportunities offered for consultation and reference work in the project room, there was not much demand for either of these.

This method of releasing each individual for work at his own natural pace, and largely along lines of his own choice, resulted in an extraordinary spread of achievement so that on the basis of the standard objective examination, the passing mark fell somewhat below the 30th centile and those who received high marks did so by virtue of having accomplished a great deal more than had been required under earlier methods.

I call special attention to the fact that the project method recognizes individual differences to the point of complete independence; it trains the student in initiative and organization; it leads to far more intensive reading than any other method now generally in use; it follows the principle of learning by doing; it is financially a very economical method of teaching; it requires and turns out more work from students than is ordinarily expected by other methods; it eliminates waste of time by the quiz master and leaves the entire time of the instructor for informal conferences with anyone who needs help; it results in a far wider spread in achievement than any other method ordinarily employed.

As the course has been conducted, it has always been regarded as a stiff course, and students who have looked for snap courses have not

[57] *Ibid.*

elected it. This has resulted in a reduction of about one-third in the normal registration. That reduction may, however, be due in large part to an increasing competition with new courses in this and other departments.

This venture has been a very interesting experiment in teaching. It has been an attempt to apply to the teaching of psychology the best techniques of project plans for self-help and learning by doing which have developed rapidly during this period from the most elementary grades up. The theory involved in this elaborate experiment deserves a book by itself. Unfortunately, with the change of administration at my retirement, this procedure was discontinued; the famous project room was dismantled on the theory that it would be possible to increase the registration of the course by a return to the traditional lecture-quiz methods which we had discarded. However, this increase did not materialize and the department will undoubtedly return to some method of recognizing individual differences and learning by doing.

The Laboratory Course

The need for training in laboratory experimentation was early met by the establishment of a one-year laboratory course in which the students worked in pairs, performing one specific experiment each week throughout the year and meeting as a class once or twice for the consideration of literature and general orientation through a particular experiment.

During my first year I wrote and manifolded a manual for a year's laboratory course. This was facilitated by the fact that during my last two years at Yale I had helped with the building of such a course in the laboratory there. The Yale course was the first formal course of its kind and constituted Scripture's largest contribution to the teaching of psychology. Since the manual was in loose-leaf form, the course was continued for forty years with progressive shift in choice of experiments as new techniques came in from year to year. It has always had a year course in a general introduction to psychology as a prerequisite, and has been a prerequisite or corequisite for research.

The Individual Plan

Throughout my administration as dean of the graduate college, I carried on a campaign against an unreasonable development in the number of graduate courses offered in the various departments and the tendency of the graduate student to elect these courses and sit

around like undergraduate and even secondary students, waiting to be "taught." I was thoroughly convinced that we teach too much, and that it would be better to allow the graduate student great freedom and encouragement for independent study.

We therefore provided that a student who could pass his qualifying examinations at the end of the first year of graduate work, might apply for the privilege of registering under the "individual plan" outlined in the catalogue, on the condition that he could present a general outline of his plan of study in co-operation with a member of the staff and with the approval of the dean.

This plan provided that he need not register for credit in graduate courses and would not be required to take any examinations until he presented himself for final comprehensive examinations with evidence of work accomplished. A report of progress was visaed by the sponsor from time to time. The student was given the privilege of visiting any courses in any department of the University that he considered profitable. Only students who demonstrated ability to pursue this plan were admitted.

We have had a number of registrations in psychology under this plan with marked success in that it tended to develop a scholarly attitude of independent thinking and investigation and trained the student to go to the sources for general information. In a surprisingly large number of cases, it led the student to enter upon post-doctoral research in psychology.

While reconstruction of graduate work in this direction is sorely needed in America, it must be recognized that our students are rarely prepared for the privilege, and that the plan is satisfactory only with good students who find a sympathetic response and fellowship in research with members of the staff.

First-hand Experiments

It has been a policy of the department to introduce the student to principles of research as early as possible by assigning some tangible subject for independent investigation. This applies particularly to majoring seniors and beginning graduate students, and the goal is, of course, to introduce the student to the possibilities and satisfactions of creative scholarship and to establish a feeling of fellowship with the teaching staff. As a rule, the student is aware of his ignorance of the subject and prefers to sit in classes and absorb as he has done through high school and college. But starting with an independent problem,

his attitude is changed from that of the absorber to that of the doer, which is the first step in the development of scholarship.

My experience with this in psychology led to a very aggressive policy for the application of this principle in all departments of the graduate college. This took the form of encouraging the beginning of publication in the senior year and the taking of a master's degree during the first year of graduate work. While there has been no specific legislation in the graduate college on the subject, the wisdom of the principle has been so generally recognized that at the present time practically all prospective students for the doctorate take their master's degrees in their first or second years. I regard the sponsoring of this principle as one of my most effective contributions to the organization of graduate work.

Chapter XI

PSYCHOLOGY IN THE FINE ARTS

Interest in this subject arose from various sources: first, my own general program to lay foundations through laboratory studies for a general science of fine arts including music, graphic and plastic arts, the dramatic arts and poetry; second, the conviction that much of the research which we have been doing in music and speech transfers to the graphic and plastic arts, particularly the analysis and interpretation of artistic talent; and third, the presence on the staff of Dr. Norman C. Meier, who had talents and interests for art and wanted to concentrate upon this field of research.

The groundwork for the approach to a science of fine arts has been laid gradually in the laboratory during the last forty years. At Yale my doctoral dissertation was on the measurement of illusions; and during my first three years at Iowa, I concentrated upon researches in this field dealing particularly with theory of vision involved in esthetics. At that time I prepared a book manuscript on the subject; but it was never published because I was not able to find a satisfactory esthetic theory under which to co-ordinate my experiments. Such principles have since then been developed elsewhere and my first-hand material — particularly my unpublished studies in the esthetics of architecture and ornamental designs — may some time become valuable as source material.

I soon realized that aside from the sensory and motor bases and the material contents of the various arts, art principles in general naturally fall into unified sets of principles which are true of all art whether we take it from the point of view of talent, art creations, or the science and philosophy of art. I therefore embraced every available opportunity to steer men into researches which would proceed into these unchartered areas on rigidly scientific principles of laboratory investigation. Thus arose the development of a scientific approach to beautiful speech as represented by Fairbanks, to philological principles as represented by Cowan, to poetry as represented by Dr. Wilbur Schramm, and before all of these, to graphic and plastic art

so successfully developed by Meier. Here I shall speak only of the origin of this development in graphic and plastic art.

THE GRAPHIC AND PLASTIC ARTS

Meier came here in 1922 from the University of Chicago with a background of interest in art and with considerable experience in drawing. We were then entering upon the large program of developing diagnostic tests, and for his doctoral dissertation, he took the analysis of talent for artistic judgment. The result of that work and the researches immediately following was the so-called Meier-Seashore Art Judgment Test. The significant thing about this procedure was the adoption of the laboratory point of view of dealing with only one factor at a time and isolating and measuring that under control. This principle came by immediate analogy from our researches in musical talents.

For example, instead of asking: Which of these two landscapes is the better work of art?, Meier employed the principle of altering one element in one picture of artistic merit. He drew two copies of the original picture: one was an exact reproduction, and the other was the same except for one feature which was altered; such as, the position of a tree, a human figure, or a rhythmic curve, which had artistic significance. He then asked the subject a specific question; such as: In which of these two pictures is the position of the girl more desirable? On this principle he knew that nothing more was involved in the judgment than the position of this figure in relation to the rest of the picture. It made the judgment specific on an identified art principle, and the material was adapted for statistical treatment. By this type of procedure, Meier was able to represent a variety of art principles without speaking of them technically or assuming that the subject knew the principle. This was a new idea in the inceptive science of art. It underlies and characterizes much of the extensive Iowa project in the science of art in this field.

About that time half a dozen other investigators in other centers developed tests for the same purpose, but these all depended upon the traditional testing method of calling for a comparative judgment upon an unanalyzed situation so that we could learn which of two pictures was preferred but had no means of knowing upon what ground it was preferred or what particular features in the picture had attracted attention.

Dr. Keppel of the Carnegie Corporation was then launching his

program for the encouragement of fine arts. He called a conference in New York in 1925 and invited me; but instead of going myself, I recommended that he invite Meier to present the Iowa point of view. This he did and was very favorably impressed with Meier's contribution. He saw the great merit that it had over the competing procedures and thus arose his interest in the development of researches on this subject at Iowa. This interest took the form of a series of grants from the Carnegie Corporation, providing research assistants and research materials for the pursuit of this project for a number of years. The result was a long series of participations and team-work which led to publications of permanent value. These publications, chiefly three volumes in the *University of Iowa Studies in the Psychology of Art*, can now speak for themselves.

One favorable element in the Iowa situation was the access to the experimental schools, particularly the Child Welfare Station, which has long been interested in the principles of artistic development of children. The Station not only gave the Meier research group facilities and co-operation but also carried on a series of investigations along other lines of artistic development. I have merely attempted to describe one of the taproots of the Iowa interests in this subject, and its relations to the laboratory; it is now evident that the experimental studies in this art have revealed a number of principles which will transfer to the psychology of music, the psychology of artistic speech and other related areas. Indeed, as the work progresses from the more elementary stages in each of the arts which we are studying, there is a tendency to arrive at common problems and to have overlapping interests in the arts.

POETRY

Ancient and venerable treatises have played an important role in fine literature and especially poetry. But our great historical utterances are now brought out for review in the light of rigid experimental testing in the laboratory. Two-thousand-year-old idols of meter, time, and stress are dissected and verified or discredited.

In order to break down barriers in this direction Schramm of the English department, working on a national foundation fellowship, spent a year in making an objective analysis of poetry readings, reducing these to performance scores from phonophotographic records. He published his first findings under the head of *Approaches to a*

Science of English Verse [58] where he dealt specifically with the analysis of the syllable, accent, stress, melodic modulation, rhyme, rhythm, the metric foot, and artistic deviation from the regular. By entering the laboratory which was fully equipped for his needs and by having advanced training in English, he did not need to waste time in developing experimental techniques or allocating issues in the theories of poetry but was able to spend a solid year in actual measurements in the subjects named.

It would be difficult to find in the learned literary tomes dealing with these problems anything commensurate with the findings of this year's work. Schramm proceeded on the assumption that the leading historical theories may be fundamentally right; and if they are, they will be confirmed by experiment; but if not, they must be modified and, in many cases, scrapped. Analysis of the objective record led to the discovery and formulation of new principles or to elements of old principles. Taking, for example, the significance of the relative roles of time and stress, which have been the center of discussion for centuries, here we see such issues on a large scale in black and white. Out of such material come significant revelations of principles of the substitution of time for stress or stress for time. Outstanding among these findings are the discovery and demonstration of some auditory illusions of hearing which have led to wrong theories on these topics. Several of these have already been demonstrated in our studies of the vibrato in music. Several other investigations on the dramatic reading of poetry have been made in the laboratory for the psychology of speech, the special objective being the development of principles of artistic feeling and thought in reading. Many of the findings in the psychology of music transfer directly to the psychology of poetry. All this is but a humble beginning, but it is indicative of the coming trend favoring exact laboratory experimentation to supplement and replace the traditional procedures.

RECOGNITION OF CREATIVE WORK FOR THE DOCTORAL DISSERTATION

Perhaps the most significant step for which I, as a "psychological" dean, was responsible in the development of research in the various fields of art was the aggressive recognition and encouragement of liberal creative work on a par with the traditional historical and technically experimental contributions for the doctorate. This was

[58] Univ. of Iowa Stud., Aims and Progress of Research, No. 46, 1935.

due in large part to the fact that most of the actual work in building up a new area is done by graduate students working for the doctorate under the direction of professors or by post-doctorate students associating themselves with a department for advanced work.

This policy was distinct pioneering among graduate schools and is now coming to be recognized by many of them. It opened a new frontier in research. In Iowa it immediately drew a superior group of students into literature, speech and dramatic arts, music, and fine arts. In these fields it dispelled the student's notion that he was merely complying with rules in producing a dissertation, and he came to feel that he was enjoying an ideal situation for the development of self-expression in his art. It was a new idea to accept an epic, a book of poems or a novel under the direction of Professor Norman Foerster and his associates in creative writing, a play embodying the theory of technical studies in play writing and actually given as a premiére performance under Professor Mabie and his technical staff, a sonata to be rehearsed and played by the symphony orchestra under Professor P. G. Clapp and his associates, or a series of portraits under Grant Wood, all with adequate scholarly historical and critical background in the treatment and the defense of the dissertation.

It may be modestly said from one point of view that this step was an advancement for these heads of new departments as it gave them adequate support and a following for aggressive approaches in their respective fields of creative work. It built up a favorable atmosphere for original investigation in the humanities; it developed a spirit of comradeship in shoulder-to-shoulder attack upon new problems with new points of view; and, most fundamentally of all, it introduced the spirit of scientific procedure into the fields of art and related subjects. This is manifested by the fact that we now have the writer's workshop, several units of really scientific shop work in the various aspects of creation and production of a play, and a full symphony orchestra, band and minor performing groups in which promising musicians can be admitted as apprentices and gradually advance into leading parts. All this requires not only notable skill but a working conception of the history and theory of the art, together with the scientific foundations in approaches thereto. A strong group of actual painters and sculptors can enter into the spirit of work which may lead to the doctorate with the same enthusiasm as the traditional painter approaches the art of painting. The pursuit of the history and theories of art and the scientific aspects of all the working materials and sub-

jects come as a result of the necessity of doing a work of art of high order.

This type of training is in striking contrast to the sterilizing and frustrating pursuit of literature, music and art in accordance with the traditional concept taken over from the field of the material sciences. The gifted student is free to do creative work.

There was considerable opposition to this innovation in the faculty; but this has gradually been overcome by the demonstration that, in these various fields of art, the fundamental principles of scientific work were richly infiltrated and came to operate naturally and effectively in view of the enticing goal in sight.

This new policy is an experiment on a large scale on motivation in learning. Back of it was the theory that the historical, theoretical, and technological background would be gained better by allowing the student to organize these as a result of immediate needs in the attempt to do a creative piece of work instead of pursuing them in the conventional way without a well-defined goal or consciousness of their value. At any rate, this new attitude created an entirely new morale in the graduate constituency and has given national leadership to the University of Iowa in these fields of research. I feel that these creative workers, given time, facilities and direction, are getting a more vital and substantial classical background than they would have been able to get by the conventional methods in the very few universities which offered graduate work in the fields of art. It should, of course, not replace highly specialized work in art which is of an historical nature.

In retrospect, it may be seen that in these new approaches to a study of the arts we have had two principles in mind. The first is that there can be a science of the artistic mind, its operations and its creations; that artistic theories may be taken into the laboratory for rigidly scientific critical review; and that the introduction of experiment may reveal countless new principles of art, may clarify terminology and definition of artistic concepts, and in general, may deepen and rationalize our insight into the nature of artistic processes.

The second is an extension of this: namely, that the artistic object may be as high a goal or evidence of scholarly achievement as the traditional historical or theoretical treatises; because, when the creation of a beautiful work of art is made the goal in a sustained program, the pursuit of it will, in the natural course of events, call for scientific investigation, historical orientation, and a general grounding in

theory, all of which will come progressively in response to felt needs.

This point of view is in line with the current trend toward the understanding and development of the emotional life as distinguished from the ultra-intellectualism of the past few decades.

Chapter XII

RETROSPECT

Locally, nationally, and internationally, psychologists have been living on a scale rising with unprecedented speed in the last half-century. The growth of psychology for this period in Iowa is in many respects typical of the growth of this discipline throughout the learned world.

In the dictionary there are approximately as many words with mental connotation as there are words with physical connotation; and, judging from the present tendencies, it seems possible that in future generations there will be as many divisions of mental science as there are divisions of physical science. There is therefore room for great diversity in the scope of interests represented in various departments of psychology throughout the world, perhaps more so in this country than elsewhere. Wherever substantial work is done in a sustained program, we find evidence of diversification and specialization.

The forty years of my administration represent a period of expansion, diversification, and integration of psychology with other subjects. This expansion has aimed to keep apace with the principal movements of the day throughout the country and in many cases has originated movements which have gained national and international recognition.

The continuity in projects has been favored by the policy of inbreeding. When a new point of view has been recognized, it has been the policy of the department to train a man for the responsibility of taking over and developing the new project. This is illustrated in a number of cases in the fields of music, reading, speech, phonetics, the psychology of fine arts, genetic psychology, clinical psychology, and acoustics. From time to time there has been administrative objection to inbreeding, but we have nearly always had the defense that the policy in question was essential where significant and promising projects were undertaken in fields not developed elsewhere.

When a psychological principle is well grounded for application in a practical field, it will take care of itself, so the tow-line of the psychological glider can be dropped. By being relieved of responsibility

along one new line of development, the department becomes free to develop other new ones.

Personally, I came into psychology on the ground floor. At that time I could say that I had visited all the psychological laboratories in the world and had seen practically all of their instruments; that I had met personally all the modern psychologists of that day; that my reading on current psychological publications was up-to-date; that I was familiar with the philosophical background and ready to take a hand in the peaceful transition from philosophy to psychology; that in taking up my new responsibilities I had enjoyed two years of post-doctorate training under the stimulating influence of Scripture; that I was zealously imbued with the necessity of a scientific approach; that I loved to ask questions of nature; that I was familiar with the activities at the three German centers, Leipzig, Berlin and Göttingen, and that I came into congenial companionship with Professor Patrick who, through his wholesome and effective leadership, was most helpful in giving the initial status to psychology on the Iowa campus.

In other words, I came to Iowa fairly prepared to take a responsible hand in the work of pioneering at the frontier of experimental psychology. From the beginning I have enjoyed the support of the administration. I have served under a succession of seven presidents, with all of whom I have been in sympathetic accord and have enjoyed the satisfaction of living to become the oldest member of the faculty on the campus.

From my induction to the deanship of the graduate college at an early age, I have had not only the freedom but the responsibility for helping in the creation of a research atmosphere, in the liberalizing of the curriculum, and in the extension of University services on the campus and throughout the state. This activity has perhaps been most effective through my participation for more than a quarter of a century in the selection of members of the University staff and the development of types of organization.

I have maintained my national and international relations with other psychologists and have enjoyed the great privilege of intimate companionship with the founders of experimental psychology, being sympathetic to what has been good in new schools and new movements in the field and have not suffered from a craving to found a new school. I have had the great fortune to have understanding companionship in sharing the labors of the rapidly expanding staff in psychology, and now have the satisfaction of seeing more than a score

of psychologists and psychiatrists participating in psychological projects in various fields on the campus. My financial budget has always been balanced. I have enjoyed unusual opportunities for travel and recreation. I have drawn inspiration and comfort from the happy and wholesome companionship in the home.

The staff in psychology has enjoyed intimate acquaintance and cooperative relations with the other departments on the campus. The laboratory has had reasonably generous financial support. One of the most helpful influences for substantial progress has been the presence of a considerable number of post-doctorate students in the department who have been able to play a tune after tuning their fiddles up to the doctorate. In the psychology of music I am particularly grateful to the liberal financial support given by Mr. George Eastman, all of his donations having been spent exclusively for stipends, generally given to post-doctorate students. The department has enjoyed generous appropriations from various foundations and associations.

My account has been limited to the tracing of origins, "frontiers in which Iowa has pioneered under my personal leadership." But *origins, original* and *frontiers* are relative terms. This is illustrated in the case of my discovery of an illusion of binaural hearing. Working in the Yale laboratory in the early '90's, I made an observation which was recognized by the department as a very interesting discovery, and I began to organize experiments for a scientific analysis of it. Five or six years later I discovered a footnote in one of Lord Rayleigh's treatises in which he recorded having made exactly the same observation and presumably treated it as an original discovery but relegated it to a footnote because it did not have any specific bearing on the topic of his treatise. Then in 1904, while experimenting to determine the laws of this illusion, I came across a reference to exactly the same thing recorded just one hundred years before as a news item in the *Berlinische Wochenschrift*. Undoubtedly other experimenters must have made similar observations but perhaps regarded them as mere curiosities. Now, who really discovered that illusion? Such experiences are relatively commonplace in the progress of science and show how deep the taproots of a discovery or invention may run. This aspect of invention and discovery applies in principle to many of the features treated in this volume.

One step of my discovery, however, was perhaps original; namely, that I immediately proceeded to organize experiments to give the observed fact a respectable status in science in spite of the fact that I

could see no practical use for it. I treated it as a striking illustration of the operation of natural law and order in normal illusions and found great satisfaction in showing how numerous these laws were and what a beautiful illustration of the predictability of human experience and behavior they furnish when operating conditions are understood. This feature is again characteristic of many of the origins and developments traced in this volume. They were often pursued as psychological facts of interest in themselves but without immediate envisagement of a theoretical or practical goal.

But when physicists were confronted with responsibility for locating under-sea weapons of war, they hit upon this phenomenon and developed instruments for a practical utilization of it through binaural hearing, leading the sound into each ear in a different wave phase. The sound of the menacing boat was heard as coming from a specific direction, but this was not the true direction of the source. A conversion table had to be used so that the apparent direction of the sound could be referred to the true direction in accordance with a law of this illusion of binaural hearing. As chairman of the committee of acoustical problems in the psychological war service, it became my duty and privilege to demonstrate how accuracy in this location of sound could be increased by the selection of listeners who were ear-minded and had high innate capacity for the location of sound, thus greatly increasing the accuracy in locating the craft. It was demonstrated, for example, that while one gifted observer could locate with an accuracy of plus or minus one degree, another equally intelligent observer might have an error of plus or minus five degrees or more. A difference of four or more degrees at that time may have meant the loss or saving of millions of dollars in property and the lives of thousands of men. Just before the Armistice, the Navy physicists developed a photographic process to take the place of the listening ear, but up to that time the determination of the direction of submarines had been made by means of knowledge of the laws of this illusion in binaural hearing which had been discovered at least three times and were regarded as useless but scientifically interesting.

Such implementation of a psychological tool has also been frequently illustrated on a smaller scale in my story of the co-operation of psychology in practical services by initiating and supervising the extension of psychological controls.

The limitation to origins and to my personal experience leaves my account of the development of psychology in Iowa incomplete. This

limitation must not be taken as an indication of ignorance of, or lack of appreciation for, the numerous contributions made by the staff which have not found a place in this account. A succession of over a hundred doctoral dissertations has undoubtedly contributed many original ideas, a good share of which have been followed up to achievement of large proportion but fall outside of the purview of this account. This is particularly true of the contributions of research assistant and post-doctoral students upon whom the department has leaned heavily for initiative and chore-work in new projects.*

It has been impossible to trace and give due credit to synchronous developments by psychologists in other laboratories, and but little emphasis should be laid on implied rights of priority which are in most cases exceedingly complicated. This failure to give a complete account of any topic is perhaps a legitimate sacrifice in the interest of unity in an autobiographical account.

It must also be borne in mind that my story does not go beyond the period of my administration of the laboratory which ended in 1936. Many notable developments in the department have taken place since that time.

Speaking to a young psychologist recently, I called his attention to the fact that psychologists in Iowa have lived on a rising scale and that this has been true of American psychologists as a class. When I asked what he thought the prospects of the future might be, he promptly replied, "Psychology is going to continue on a rising scale, perhaps even steeper." In this optimistic opinion I heartily concur.

The psychologist of today who has come into an established field of science can hardly realize what real pioneering in the field has meant. He walks easily into a field of well-established techniques, ample equipment, well-mapped programs, unlimited companionship, and a fairly assured career. He is in danger of ignoring, or at least being ignorant of, the vast heritage which the psychologists of my generation came to possess through the philosophers and scientists in other fields. He smiles at our limited conception of problems, the early sources of error in experimentation, and the crudeness of contributions made in the early stages as compared with those of today.

Conscious of this new-rich attitude of the present generation of psychologists, I felt that in this autobiographic sketch I might gain some sympathy by pointing out in the *Introduction* the parallel be-

* Iowa was perhaps the first university to give effective status to the term "research assistant."

tween life at the physical and at the psychological frontiers in the state of Iowa. The physical frontier life is easily understood; the understanding of the mental frontier is more subtle.

I have been helped by thinking of the parallels in the two situations. There is the discovery of a new vista presenting unlimited opportunities in stepping into responsibility for exploration and development of this new territory, full of fascination; but the progress is modest and requires a venturesome spirit. It is a simple life, being satisfied with the meager resources immediately available, living close to nature, being satisfied with what you have, and being blissfully ignorant in advance of the coming world of inventions, resources, power, and all other kinds of wealth which have been placed at our disposal within a lifetime. There is a satisfaction in developing habits of economy in a natural budgeting of resources. There is the thrill in exercising ingenuity and leadership, the freedom from artificial social situations and obligations in the uninterrupted pursuit of your work, and the cultivation of those social and artistic resources which are within your reach at present.

On the other hand, there are endless varieties of hardships, both physical and mental; the danger of being lost in the storms and stresses, the pinch of a meager economy, the necessity of being a jack-of-all-trades, both with head and hand. There is the necessity and privilege of learning to do everything that has to be done in the situation. But there is unlimited opportunity for growth through personal maturation, social progress, and achievement in your job. And, once having survived, one sees these hardships in retrospect as easily offset by approaching the whole situation in the attitude of play and enjoying the privilege of living in an era of a rising scale in the Land of the Free.

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It has been drawn largely from the listings in the *Psychological Index* and the *Psychological Abstracts*. The first ninety-seven titles are abstracted in a commemorative volume.[59] The bibliography is carried up to date of this printing.

The following abbreviations are used for local publications:

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