SOME UNSOLVED PROBLEMS IN HUMAN ADJUSTMENT[1]

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ONE of the current fashions in psychology is to define its subject-matter as the organism in its environment, and the subject-matter of human psychology as the whole man in his whole environment. This orientation derives from many sources, prominent among them being an increasing knowledge of the close integration of all parts of the organism through neural and chemical mechanisms, and a growing recognition of environmental influences in the development of behavior. In this setting it is logical that one of the main themes of psychology should be the *adjustment* of the organism to its environment. It is the purpose of this paper to assemble for inspection certain peculiarities of so-called behavioral adjustment and to attempt to show their theoretical and practical significance.

The researches of Cannon,[2] Barcroft[3] and numerous other physiologists have demonstrated a remarkable capacity of the various organs and fluid media of the human body for establishing and maintaining a state of equilibrium or balance. They have likewise demonstrated the absolute necessity for the life of the organism of holding this balance within a slight margin of variation. Furthermore, they have gone far toward a complete explanation of the processes through which the equilibrium is maintained. This condition, called homeostasis by Cannon, is well illustrated in the case of the acidity-alkalinity balance of the blood, as reported by Cannon (p. 169).

> Blood has a slightly larger concentration of OH-ions than of H-ions, the index figure being approximately pH 7.4. Even minor variations from this reaction, which is just on the alkaline side of neutrality, are dangerous. If the hydrogen-ion concentration rises, so that the figure changes only to pH 6.95, coma and death result. And if the hydrogen-ion concentration falls, an increase in alkalinity as trifling as that indicated by a shift from pH 7.4 to pH 7.7 in the index figure, brings on tetanic convulsions. . . . In health, the variations from the normal reaction do not extend far enough beyond the close confines to impair the activities of the organism or to threaten its existence. Before such extremes are reached agencies are automatically called into service which act to bring back towards the normal position the disturbed state.

A similar need for establishing and maintaining a state of adjustment in the organism as a whole in relation to its external environment has been described by Raup.[4] He calls it the need for biological equilibrium and thinks of it as a state of metabolic balance. As analogous to the concept of Cannon, this biological equilibrium might be called organismic homeostasis. The maintenance of this balance or the return to it if it is disturbed is necessary for normal life. The mental reaction of the organism thus in equilibrium is a state of "good feeling" to which the author gives the name of "complacency." A condition of off-equilibrium, whose mental counterpart is loss of complacency constitutes a maladjustment. The return to complacency from a condition in which it is disturbed is the sole source of human satisfaction or pleasure. Inability to reestablish complacency means abnormality. Raup reduces all habit formation, learning, reflection and reasoning to a struggle to regain complacency, concomitant with the struggle of the organism to reestablish metabolic equilibrium.

For our present purpose there is no need to follow Raup into all the applications of his concept or indeed to go beyond his idea of a tendency toward a biological or metabolic equilibrium in the organism. The concept has been developed from the researches of Lillie, Jennings, Child, Herrick, Crile and many other biologists and physiologists. Indeed, when our knowledge of human physiology and psychology is complete, it may well be that organ homeostasis and organismic homeostasis will reduce to the same fundamentals. Thus an organismic reaction such as strenuous exercise with its excessive perspiration and consequent loss of body fluid may create an overconcentration of salts within certain of the body cells. There is set into action the machinery of the organs for reestablishing the balance (an organ reaction), which extracts fluid from the blood and lymph (the process of osmosis). This creates a water deficiency, whereupon the organism becomes thirsty. Its relation with its environment is thereupon disturbed (an organismic reaction), it seeks to allay its thirst, and doing so both restores the "biological equilibrium" and gives intense satisfaction. Thus, organismic reaction has led to organ unbalance, which in turn creates a disturbance of organismic equilibrium with the consequent struggle of the organism to restore it.

This instance will serve as a sample of one type of disturbance of organismic equilibrium with its reflection in a changed state of complacency. Most fre-

[1] Address of the vice-president and chairman of the section for Psychology of the American Association for the Advancement of Science, Indianapolis, December, 1937.

[2] Cannon, "The Wisdom of the Body," 1932.

[3] J. Barcroft, "The Architecture of Physiological Function," 1934.

[4] R. B. Raup, "Complacency: The Foundation of Behavior," 1925.

quently, however, it is the social disturbers of equilibrium reflected in changes in complacency which attract our attention. Our knowledge of the mechanism of these social disturbers is at present inadequate to enable us to associate them directly with the disturbers of organ equilibrium.

It is the purpose of this paper to present some evidence from psychological research concerning adjustment which does not readily lend itself to interpretation in terms of the struggle for equilibrium either organic or organismic. If the concept of balance or equilibrium were to be sufficiently extended to cover such cases, it might have to be conceived as a behavioral homeostasis, or perhaps even a "purposive homeostasis." It would, thereupon, become necessary either to demonstrate the positive correlation of these forms of homeostasis with biological or metabolic equilibrium, or to conceive of a state of complacency or mental equilibrium in the individual wherein it is in a state of organic disequilibrium or moving toward such disequilibrium.

Morgan,[5] working in the Columbia Laboratory of Psychology in 1916, attempted to measure the effects of noise upon efficiency of human performance. He reached what then appeared to be a surprising result, that not only was *output* of so-called mental work (in terms of which efficiency was measured) not always reduced but was frequently increased. It seemed as though the individual set for himself a certain level of performance, and in the struggle to maintain this level in the face of difficulties sometimes rose above it. This outcome, contrary to his hypothesis, led him to suspect that the work done under noise, although not reduced in quantity, might cost the organism more in effort per unit of work. The actual efficiency, measured in terms of output over cost would in such a case be reduced as he expected it would. Elaboration of his technique disclosed such evidence of increased effort in the form of changed breathing, talking aloud and increased tension in the muscular reactions. The experiment was further extended to the lifting of weights in which the energy expended could be objectively computed in terms of load, time and distance. Under appropriate instructions to keep the effort always at the maximum, it was found that in spite of instructions the effort expended varied with the load to be lifted, while the lifting time tended to be held constant.

> After one has been pulling a weight of 2,440 grams with what he supposes to be the maximum force he is able to exert, when unexpectedly a weight of 7,770 grams is substituted for the lighter one, his force at the very beginning of the pull is on the average 2.5 times as great as the supposedly maximum force previously used. The time taken for this adjustment ranges from .025 to .091 second with an average of .054 second. This is much shorter than the simple reaction time. . . . Since this adjustment is so rapid it can not be a conscious reaction. It must be a reflex or a local muscular adjustment.[6]

If any equilibrium or balance was being sought or maintained in this experiment it was not a metabolic balance, but consisted of a uniform rhythm or rate of movement. Morgan called this rate of work the "congenial pace." Here we seem to have an instance in which the metabolic equilibrium has, to a superficial analysis at least, been disturbed and remained disturbed when the experimental conditions were especially conducive for it to hold steady by the mere slowing of the rate of response. The state of complacency or satisfaction implied in Morgan's "congenial pace" is shown therefore to be associated with a state of off-equilibrium or increased expenditure of energy.

Davis,[7] using a more refined technique which involved the measurement of muscle action potentials, has confirmed the findings of Morgan. He has recorded the amount of increase of action potentials when distractions are introduced in the course of mental work. Meeting distractions does definitely increase muscular activity if action potentials are indicators of such activity.

Johnson,[8] in studying the sensitivity of the eye to differences in light intensity by means of reaction time technique, reports what he calls an incidental discovery. It is that under certain circumstances the more difficult the task of observing the light stimulus, the better is the quality of the performance as measured in terms of reaction time. He explains this discovery by saying that "the more unfavorable the conditions of observation the greater the degree of 'volitional attentive effort.'" This experiment furnishes an instance, then, of adjustment of attentive effort to maintain a given quality of reaction. That the adjustment overshoots the mark, so to speak, as it sometimes did in the experiments of Morgan, does not lessen the significance of the adjustment. There is, to be sure, no direct demonstration of increased energy expenditure in Johnson's subjects, but "increased volitional attentive effort" implies increased muscular tensions and these should have their counterpart in altered metabolic rate. Here, as in the study of Morgan, the individual does not get his satisfaction from maintaining a uniform level of energy expenditure but appears to sacrifice the maintenance of such a level in order to attain or maintain a standard of achievement.

[5] J. J. B. Morgan, *Archives of Psychology*, No. 35, 1916.

[6] J. J. B. Morgan, *Psychol. Rev.*, 27: 95–111, 1920.

[7] R. C. Davis, *Indiana Univ. Pub. Science Series*, No. 3, 1935.

[8] H. M. Johnson, *Jour. of Exp. Psychol.*, 1: 1–44, 1924.

The research of Thorndike and collaborators[9] on the effects of temperature and humidity upon mental efficiency offers similar data. Here the supposed obstruction to performance was such high temperature and high humidity as to make an extremely uncomfortable working milieu. As in the case of Morgan's use of noises, however, the output of mental work was not only not appreciably reduced, but in some cases was actually increased. There was a tendency to maintain uniformity of output, that is, to meet the disturbing conditions in some fashion. No measures of actual effort or energy expenditure were employed in this experiment so that any such changes would have to be inferred. Thorndike did, however, assume that an adjustment of some sort to the unfavorable conditions was being made and attempted to determine whether it was intentional or whether it was even known to the worker that he did so adjust. Manipulation of the experimental technique, so that it would not be possible for the worker to know either the quantity or quality of the work being done at any time gave the same evidence of adjustment. It seemed, therefore, that whatever adjustment was being made, whether by increased effort or otherwise, was not a consciously directed process. Could such a process of adjustment have biological equilibrium or complacency as its goal? Or was the goal some standard of achievement however set, some "congenial pace," which was sought regardless of cost to the organism?

The studies of Morgan, Johnson and Thorndike have been selected for report. Many others could be cited from nearly every realm of psychological research, showing a tendency to meet obstructions or difficulties by maintenance of pace in respect to quantity or quality or of rate of performance at the suspected or demonstrated cost of increased effort. In fact, the phenomenon is so universally present that Morgan in the study just quoted believes it to be a manifestation of a fundamental reflex present in all living tissue. It appears in its most rudimentary form, according to him, in the adaptation of the response of a single muscle to the resistance which it meets, where the greater the tension exerted upon the muscle the more strongly it contracts. This is a phenomenon noted many years ago by the physiologist Fick.

A peculiarly organismic or behavioral type of adjustment is demonstrated in the recent experimental studies of aspiration level as performed by Frank[10] and others.[11] In these instances there is no obstacle in the physical environment to be overcome, but the individual recognizes a certain level of adequacy in his performance.

> One thinks of himself as just so good. This is the "ego level" of the person. At the same time, there is an aspiration level—not the highest level imaginable, but the level which the organism sets as its goal and toward which it hopes it may possibly rise. The aspiration level is not set absurdly far beyond the ego level. The ego level is kept as high as it can be kept. The organism wants more than it conceives itself able to achieve. It constantly readjusts the two levels in the light of experience so that the ego level may be kept as close as possible to the aspiration level but yet never so close as to produce the shock of disappointment on sober recognition that the ego is not as good as one had hoped.

To use another terminology, of Sherif[12] particularly, one performs a task in a certain "frame of reference." It may be predominantly a personal or a social one, but whichever it is, it sets the level of aspirations. This level is just what its name implies, a goal toward which the individual aspires. He makes an effort to reach it. Failure to do so creates tensions and evidences of dissatisfaction.

One notes certain resemblances between the aspiration level of Frank and the "congenial pace" of Morgan. Both set a gait for achievement which the individual strives to reach and maintain. Morgan finds the tendency to maintain a pace in the face of obstacles a characteristic of all living organisms from the lowest to the highest. Frank finds it a characteristic of personality structure differing from person to person, but the relationship between aspiration level and past performance appears to be a "relatively permanent characteristic of the personality." Whether aspiration level will be reducible in the last analysis to an expression of the more fundamental congenial pace only further research will tell. Both, at any rate, imply setting a gait for achievement which the individual makes an effort to reach and maintain.

There grows out of this discussion a question of great theoretical and practical importance. Are these adjustments that are made in order to maintain some standard of performance in the presence of obstacles or to reach a higher level of achievement in accordance with level of aspiration costly to the organism? Or is this whole process one which goes on while the organism remains in a state of biological or metabolic equilibrium or approaches that state? For instance, does or does not work done in the midst of noisy surroundings or in atmospheric conditions of excessive heat and humidity take its toll of human energy? Do incentives of all sorts commonly employed to increase effort and thereby to increase efficiency really increase efficiency, or are they more costly when efficiency is properly

9 E. L. Thorndike, See Report of the New York State Commission on Ventilation, Chap. 10, 1923.

10 J. D. Frank, *Am. Jour. Psychol.*, 47: 285–293, 1935.

11 G. Murphy, L. B. Murphy and T. M. Newcomb, "Experimental Social Psychology," pp. 212 *ff*., 1937.

12 M. Sherif, "The Psychology of Social Norms," 1936.

computed? When the cost is measured in terms of effort, the researches quoted would seem to give a positive answer to these questions. The answer appears also to be positive when cost is measured directly in terms of muscle tensions or less directly in terms of action potentials of muscles. What is the answer when the efficiency of the organism as a whole is measured in terms of output over cost, the latter being expressed in terms of the energy expended by the organism in performing a unit of work?

An attempt has been made in our laboratory during the last several years to get a more direct answer to this question by measuring the metabolic cost of physical and mental work under a great variety of conditions, such as quiet and noise and with different incentives to increased performance. The work is still in progress and the question has not received a final answer, yet there are certain indications of what that answer will be. We[13,14] have studied the metabolic cost of doing mental work such as adding columns of figures in a quiet room, in a room where the noises from a large number of typewriters were reproduced phonographically, and where the noises of a busy city corner were similarly reproduced. When the noises were introduced there was a temporary reduction in output of work accompanied by an increased metabolism per unit of work done. This is according to expectation derived from the studies of Morgan. But if the noise is continued, the worker in a surprisingly short time returns to his normal output and there is a corresponding return of the metabolic rate toward the normal. The data are highly variable, the number of subjects upon whom they have been obtained is few, and the duration of the experiments which we have thus far been able to complete has been too short to justify any very positive statements at the moment. But it does seem as though the organism has some way of meeting such obstacles to performance as were employed in our experiments so that after a kind of adjustment period output may be maintained at its normal pace without the expected increase in energy cost per unit of work. Just how long the organism could thus continue without loss in efficiency after the adjustment had occurred or whether such loss would ever occur is a problem in itself.

An interesting bit of corroborative evidence for these metabolism findings comes from the measurement of muscle action potentials. Davis[15] measured the changes in tension which certain voluntary muscles undergo when an individual is subjected to a noise distraction over a period of time. On the first day of the experiment the magnitude of the action potentials was high, but even within a single sitting there was a noticeable decrease. This persisted until the following day, and in addition there was a cumulative adaptation over a series of days, so that at the end of five daily experiments relatively little tension remained.

The data from our experiments on the effects of incentives[16] are still less final, but the trend of the indications is in the same direction. The mental work consisted in adding columns of two place numbers and the incentive was a money bonus ranging from a few cents to five dollars for exceeding one's previous record in a spell of work. Incentives do seem capable in some instances of increasing output with no increase in metabolic cost per unit of work and at times even with a lessened cost per unit of work.

We have come at last to the unsolved problems to which the title of this paper refers. How are such disturbers as noises, lights, pains, heat and humidity met and dealt with so that effort may be exerted without increasing energy expenditure or so that neither increased effort nor increased energy expenditure need occur. Shall we at this point be forced to take leave of a purely mechanistic interpretation of behavior wherein an increase of load calls for an increase of power? Shall we be forced to rest the burden of explanation upon the exercise of the will! Let us look for alternative suggestions, even though support for them may be tenuous.

Introspective reports taken during the distraction studies may throw a little light upon our problems. Distractions have generally been defined in objective terms. A noise is produced while one is working at arithmetic problems, lights are flashed while one is listening to words to be memorized, high atmospheric temperatures are introduced while one is judging the quality of compositions. Are they distractions? Strictly speaking, they are distractions or distractors only if they distract. Many of the introspective reports show that when the objective conditions for distraction are present, the subject is not distracted. He may say that he "paid no attention," he "was not bothered" or he did not "notice the supposed disturbers." In such cases no increased effort seemed to be necessary and the output, as would be expected, was normal.

To account for the fact that distractors sometimes do not decrease output of work and may even increase it, by saying that distractions do not distract is merely raising another question which demands an answer. Why do environmental conditions that are called distracting not distract? How can the organism "not be bothered" or just not pay attention? One suggestive bit of evidence to meet these questions comes from the research of Davis just described in which muscle action potentials decreased during a five-day distrac-

13 F. L. Harmon, *Archives of Psychology*, No. 147, 1933.
14 Rounds and Poffenberger (unpublished).
15 *Op. cit.*

16 Rounds and Poffenberger (unpublished).

tion experiment. Whether such changes in muscle tension are causes or consequences of the adaptation can not be stated definitely at this time. But if the former can be shown to be the case, then it would be a good guess that the peripheral sensory mechanisms together with the voluntary musculature taking part in the sensory adjustment process performed a protective function against distractors. By a reduction in tension or relaxation they would transmit the otherwise disturbing stimuli at a reduced level of intensity, a level too low for effective competition with more favored events.

If the tentative explanation just given seems to be weak or faulty, another is available that is almost exactly opposite in its implications. It may be introduced by the observation that not all conditions of distraction are resolved by ignoring them, or by not being bothered. The effort clearly demonstrated by Morgan is the response more commonly noted, particularly at the onset of a disturbance. Thereby the subject seems somehow to keep his performance to a prescribed level, or in attempting to do so to exceed it.

What is the utility of the added effort, demonstrated by Morgan and inferred by both Johnson and Thorndike, in maintaining a level of achievement or in raising that level? Is such effort merely the subjective experience of wasted energy? The answer is not immediately obvious from a casual examination of the accessory mechanisms that are thus brought into action. It is the old physiological and psychological problem of dynamogenesis, but some light is being thrown upon it by current researches. The work of Freeman,[17] who measures the specific tension patterns in groups of muscles by means of mechanical levers, and that of Jacobson[18] and Davis,[19] who measure muscle tensions in terms of action currents, establish without question the existence of the tensions during effort. The work of Bills[20] and of Block,[21] who deliberately induce muscle tensions in the course of mental work and measure their effects upon performance, gives quantitative evidence of the reinforcement that may thus be produced. And the work of Hartmann[22,23] and others in their demonstration of the increase of subjective intensity of certain sensory experiences as a result of the simultaneous stimulation of other sense organs gives a hint of a possible mechanism of reinforcement in the presence of sensory distractors. If the stimulation of *other* sensory mechanism raises the subjective intensity level of those experiences mediated by the sense having dominance at the moment, the latter should thereby become the more effective. In certain favored circumstances, therefore, the expected consequence of so-called distractors should be an increase in the efficiency of behavior. Are these favored circumstances to be found in the states of muscular tension such as those whose effectiveness has been demonstrated by Bills?

Two types of explanation for the meeting of distractions have now been offered: One was derived from introspective reports of certain subjects who were not distracted and from the study of the process of adaptation to distractions showing a reduction of muscle tensions with time; and the other derived from the study, particularly, of that period immediately following the onset of a distraction and showing a reinforcement by way of the activation of accessory mechanisms. These two views, seemingly antagonistic, may be tentatively reconciled in either one of two ways.

The whole complex process of reacting to competing stimuli may be conceived as a process of sensory conditioning. Cason,[24] after determining the subjective intensity of certain visual and auditory stimuli when presented separately, gave his subjects what he called a conditioned response training. This consisted in "evoking simultaneous visual and auditory responses a large number of times." Before the training, a stimulus affecting either one of two senses had the effect of increasing the subjective intensity of the other, thus supporting the findings of Hartmann mentioned above. "But after the conditioned response training, a stimulus affecting one of the two senses had the effect of decreasing the intensity of the other simultaneous sensory response." Thus, our two supposedly conflicting interpretations would seem merely to cover the two stages of an adjustment process, the first a reinforcing and the second a weakening one. There would remain to be explained just why in the first case the "appropriate" stimulus would be reinforced and why in the second case the distracting stimulus would be weakened. However, one need only appeal to the concept of "dominance" as elaborated by Razran[25] to account for such selective action in the phenomena of conditioning.

Or, one may accept the increased tensions noted by Morgan as authentic and interpret the reduced tensions demonstrated by Davis as a *shift of tensions* to new muscle patterns with a reduction of tension only in those muscles on which measurements were at the time being made. The decreasing metabolic cost as adaptation to the distraction progresses would indicate merely that the later tension patterns were less

17 G. L. Freeman, *Jour. Gen. Psychol.*, 5: 479 *ff.*, 1931.
18 E. Jacobson, *Am. Jour. Psychol.*, 44: 677 *ff.*, 1932.
19 R. C. Davis, *Indiana Univ. Pub. Science Series*, No. 5, 1937.
20 A. G. Bills, *Am. Jour. Psychol.*, 38: 227 *ff.*, 1927.
21 H. Block, *Archives of Psychology*, No. 202, 1936.
22 G. W. Hartmann, *Jour. Exp. Psychol.*, 16: 383–392, 1933.
23 G. W. Hartmann, *Jour. Exp. Psychol.*, 17: 813–822, 1934.
24 H. Cason, *Jour. Exp. Psychol.*, 19: 572–591, 1936.
25 H. S. Razran, *Psychol. Rev.*, 37: 25–43, 1930.

extensive or less complicated patterns or functioned more economically than the earlier ones. The tension patterns would shift but would never disappear. There is evidence for such shifts of pattern in the experiments of Freeman[26] and of Jacobson.[27] And the data of Jacobson give some support for the view that a tension pattern is always present during mental activity, since such activity is reduced to a minimum during a state of muscular relaxation.

Our possible explanations of the economy of adjustment are still not exhausted. Let me merely suggest a third, namely, the *law of least action* as propounded by Wheeler.[28] Any situation which presents an obstacle creates a condition of strain or tension. And any effort to overcome strain is an activity directed in a line of least action. Wherever there are two or more potentials belonging to a particular energy system motion takes place from the higher to the lower stress until an equilibrium is established. An illustration employed by him is particularly pertinent at this point. I quote freely: A lecturer and an indifferent audience.

> Why was the audience indifferent? But, first, what is indifference? It is a strain. The audience was bored; the seats were hard; the air was stuffy. The people preferred other activities than listening to an uninteresting speech. Accordingly, movements and attitudes on the part of the audience were not only symptoms of this strain, but they were also efforts to compensate for it. Had it not been inhibited by fear of breaking a long established custom and thus subjecting itself to criticism, the audience would have walked out to relieve itself of this strain, but courtesy to the lecturer prompted it to remain in the hall and to make the best of it.

They obeyed Wheeler's law of least action!

I hope that the several tentative explanations that have just been proposed have not served merely to belittle the remarkable fact that the human organism can adjust itself to changing conditions with an economy that man-made mechanical devices can not imitate; or to give the lie to the title of this paper which says that these problems are still unsolved. They are unsolved but not insoluble. The unknowns are gradually being whittled away. In the meantime, let us remind ourselves that organismic homeostasis is not inactivity, that complacency is not laziness, that the law of least action does not imply a saving of one's energy, and finally that having aspirations and striving to attain them are normal human organismic reactions deeply rooted in mechanisms as fundamental as the reflex.

OBITUARY

JOHN KUNKEL SMALL

Dr. John Kunkel Small, chief research associate of the New York Botanical Garden, died at his home in Bronx Borough, New York City, on January 20, 1938, in his sixty-ninth year. He was of German descent, and was born in Harrisburg, Pennsylvania, on January 31, 1869. At 19 he entered Franklin and Marshall College at Lancaster, Pennsylvania. His first botanical paper was published during his sophomore year, and six more followed before his graduation in 1892. Of these early contributions to botanical science, two were concerned with mosses, and two were prepared in collaboration with his classmate, A. A. Heller, well known for his later work in the botanical field.

A few months after his graduation from Franklin and Marshall, he entered Columbia College, now Columbia University, with a fellowship in botany, and there he remained for six years, studying and serving as curator of the herbarium. His attention then, and throughout the years that followed, was concentrated upon the taxonomy of flowering plants and the flora of the southern United States.

Upon his arrival in New York he commenced work at once upon the genus Polygonum, and published five preliminary papers upon this subject. When he received his degree as a doctor of philosophy in 1895, his volume, "A monograph of the North American species of the genus Polygonum," was the most sumptuous American botanical thesis ever published. Meanwhile he had studied various other plants in his customary critical way, and had begun work on the Oxalidaceae, with which his name has since been closely associated.

His interest in the southern flora began at least as early as the summer of 1891, when in company with Heller he made a trip to western North Carolina, and continued unabated throughout his life. During his six years at Columbia he prepared a series of fourteen "Studies in the botany of the southeastern United States"; these comprised more than a hundred pages, and were published, as were most of his botanical writings of this period, in the *Bulletin* of the Torrey Botanical Club.

He had joined the Torrey Club in January, 1890, two and a half years before he made his home in New York, and always identified himself with this, the oldest American botanical society; he was elected an honorary life member in 1934. He became a member

26 *Op. cit.*
27 *Op. cit.*
28 R. H. Wheeler, "The Science of Psychology," Chap. 3, 1929.