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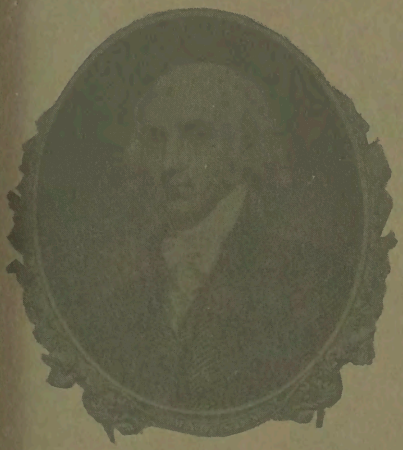

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ABSTRACTS OF MASTERS' THESES

RAKHMETOV IN N. G. CHERNYSHEVSKY'S WHAT IS TO BE DONE?: THE ORIGINS, MEANING, AND HISTORICAL IMPACT OF THE CHARACTER

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After his arrest on July 7, 1862, Nikolai Chernyshevsky spent twenty-two months without trial within the confines of the infamous Petropavlosk Fortress of St. Petersburg, where he wrote probably his finest work, a utopian novel, *What Is To Be Done?*.[1] Upon its publication in the radical journal *Sovremennik* (*The Contemporary*) in 1863, after having passed the official censor as the result of a typical oversight,[2] Chernyshevsky was tried and found guilty, subjected to a horrible public (mock) execution, and sentenced to hard labor (1864-1872) and exile (1872-1883) in Siberia. All rested on the basis of circumstantial, manufactured, or falsified evidence. Although he was aware of and associated with the various "subversive" movements of the period, and his ideas did serve as the inspirational foundations for many of their programs, Chernyshevsky was never an actual participant or leader as alleged by the tsarist tribunal which pronounced sentence upon him. His "guilt," if any, was primarily by association only. Chernyshevsky's partisans and adversaries in the Russian intellectual community and from around the world agreed that in his case the government had made a grievous mistake and gone too far. This

[1]See: N. G. Chernyshevsky, *Chto delat'?; iz rasskazov o novykh liudiakh* ("What Is To Be Done?; From Tales about the New People"), in *Polonoe sobranie sochinenii* ("Complete Collected Works"), 16 vols., ed. by V. Ia. Kirpotkin, B. P. Kozmin, P. I. Lebedev-Polianskii, and others, XI (Moscow: Gosudarstvennoe izdatel'stvo "Khudozhestvennaia literatura," 1939-1953).

[2]This novel originally passed the censor unread and by mistake. The high commission investigating Chernyshevsky's case passed over it as irrelevant to its proceedings and the regular censor, assuming it to have been approved by the lofty official body, also passed it. After the first publication of *What Is To Be Done?* in the March, April, and May issues of *Sovremennik* the mistake was immediately corrected and the book was quickly banned; this prohibition was not officially lifted until after the promulgation of the October Manifesto in 1905.

episode remained a mark of tsarist cruelty in the minds of future generations.

What Is To Be Done? represented the climax of Chernyshevsky's already impressive career as a radical publicist and critic and remained one of the most influential pieces of revolutionary literature in Russia for more than two generations after its initial appearance. In its pages could be found not only Chernyshevsky's economic and political views in a highly refined state, but also to a somewhat lesser extent, his views on aesthetics and art. It was a very "political" work, and in the traditional aesthetic sense, there was nothing attractive about it. But to Chernyshevsky, under the right conditions, politics and art were almost synonomous. However considered artistically, this volume definitely had an immense moral influence on the youth of Russia and rapidly became the first and chief "catechism of nihilism."

Professionally, *What Is To Be Done?* could be considered Chernyshevsky's last-will-and-testament. His principal objective in writing this book was to convey his ideas on the social, economic, and political problems facing contemporary Russia. It is apparent from the text that the situation of women, the formation, development, and positive aspects of Fourierist-like producer cooperatives, and the real nature of social service, among others, were all issues which at this time weighed especially heavily upon Chernyshevsky's mind.

On a different level, *What Is To Be Done?* was also intended to serve as a resounding refutation of and a revolutionary corrective to one of the most significant of Turgenev's novels, *Fathers and Sons,* which first appeared in print in 1862. Chernyshevsky was upset particularly by the confused, moderate, and seemingly anti-radical tone of this work. Bazarov, the self-proclaimed "nihilist"[3] and the main character of *Fathers and Sons,* was a rather vague and unfavorable representation

[3]With the character Bazarov, Turgenev first coined and defined the term "nihilist." Chernyshevsky and the other great leaders of Russian nihilism freely accepted the concept and eventually adopted the label, but quickly rejected the character as poorly developed and too unrealistic. Only the ultra-radical Pisarev eventually came to accept the character.

of both the martyred Chernyshevsky and his recently deceased comrade Dobrolyubov. Consequently, Chernyshevsky, fully understanding the potential power of literature, feared that an artist of Turgenev's stature could succeed in delivering a destructive counterrevolutionary blow if his work were allowed to stand unchallenged and unanswered. *What Is To Be Done?,* as its subtitle (*From Tales about the New People*) indicated, was a story of those rare individuals whom Chernyshevsky and his friends and associates, those who have come to be known since as the Russian "nihilists."

In *What Is To Be Done?* perhaps Chernyshevsky's single most significant and lasting contribution to Russian literary tradition and revolutionary thought was Rakhmetov. At various points referred to as "an unusual man" and "the rigorist," Rakhmetov was a relatively minor character who had a major impact. He was a new type of radical hero and the perfect incarnation of Chernyshevsky's "superior man." Rakhmetov appeared only twice in the entire novel. Early in the third chapter he was introduced briefly as part of a group—consisting of Vera Pavlovna and Dimitry Sergeich Lopukhov,[4] also "new people" and Chernyshevsky's main characters, and their associates—on a regular Sunday junket to an unnamed island in the Neva River for a picnic. From Rakhmetov's participation in the day's events all that could be learned of him was that he was Dimitry's friend, an intellectual, and "a recognized athlete."

Rakhmetov's only other appearance was in the latter part of the same chapter where Chernyshevsky allocated one of the longest subchapters in the book to him. It was Rakhmetov whom Dimitry had entrusted to bring Vera the word about the true nature of his supposed suicide, which he faked to allow her to marry the man she really loved, Alexander Matveich Kirsanov.[5] All the reading public was ever given to know about

[4]The name Lopukhov is derived from *lopukh',* the burdock envisioned by Bazarov as growing up from his grave after others had taken advantage of his contributions. With Dimitry Chernyshevsky is obviously carrying out a self portrait.

[5]Here is a character lifted directly from *Fathers and Sons.* Chernyshevsky takes Turgenev's weakling and foil to Bazarov and makes of him a "new man." Chernshevsky probably intended this transformed and regenerated Kirsanov to stand as a memorial to Dobrolyubov.

Rakhmetov is here. In totality, he stood head and shoulders above Dimitry, Vera, and Alexander, who although usually dauntless, ". . . experienced in his [Rakhmetov's] presence, a form of fear."[6] But the Lopukhovs' servants were not even the least bit timid when around Rakhmetov. Chernyshevsky indicated that people like Rakhmetov were of a rare and valuable breed.

Rakhmetov belonged to one of the oldest and wealthiest families in all Europe, but he had openly rejected his heritage. He used his fortune to support various popular causes and an unknown number of students at several European universities. Now twenty-two years old, he had already attended one university and had taught at another. Physically and spiritually, Rakhmetov was a highly self-disciplined person. He had once worked on the Volga River as a boathauler and had been dubbed "Nikitushka Lomov" by his comrades after the legendary "Mike Fink-type" of the Russian riverboatmen. Rakhmetov fed himself almost exclusively on raw beefsteak for strength; otherwise he forced himself to live like the common people. As perhaps the ultimate test of his stamina, he even spent a night "resting" on a bed of nails. Neither was Rakhmetov less of a mental titan than a physical one. He was an avid reader and had a command of many languages; he taught himself by studying the respective dictionaries. He succinctly commented on works ranging in diversity from Newton's *Observations on the Prophecies of Daniel and the Apocalypse of St. John* to Thackeray's *Vanity Fair*. Rakhmetov here functioned as the chief vehicle for the voicing of Chernyshevsky's views on aesthetics and art. Through Rakhmetov Chernyshevsky discussed the state of contemporary literature:

> On each subject there are but a few superior works; all others contain nothing but repetitions, rarefactions, modifications of that which is best expressed in these few. There is no need to read any more than these; all other reading is nothing more than a waste of time. Take, for example, Russian *belles lettres*. I tell myself: "I first shall read all of Gogol's works." In the thousands of other novels I merely must read five lines

[6]Chernyshevsky, *Polnoe sobranie sochinenii*, XI, pp. 517.

> on five separate pages to realize that I shall find nothing in them but Gogol despoiled.[7]

Rakhmetov was truly a most amazing fellow. As Kirsanov so aptly put it, "He is worth more than the sum total of us all."[8]

Rakhmetov's stated mission was to console Vera, to deliver a letter from Dimitry to her, and to explain further her husband's intentions. In the course of these events additional information about Dimitry and, to a lesser extent, Vera was revealed. Rakhmetov held Dimitry in high regard, and came to see Vera in a similar light. Chernyshevsky clearly intended for Rakhmetov's esteem to elevate the Lopukhovs in the eyes of the reader; Chernyshevsky was well aware of the impression a character like Rakhmetov would make. Rakhmetov also gave Vera needed self-confidence and direction for the future. Like a worthy knight in a medieval romance, having fulfilled the requirements of his deputation and touched the lives of all around him in the process, Rakhmetov exited. Although Chernyshevsky was prevented from saying so directly, he strongly implied that Rakhmetov was off to help initiate the popular revolution.

Rakhmetov's literary and historical origins were numerous and diverse. Hints of the appearance of a new sort of hero were to be found previously in Herzen's short and unnoticed novel of the 1840's, *Who Is To Blame?*. Other, more accurate portrayals of this type were forthcoming between 1855 and 1865. Turgenev's Insarov, the Bulgarian revolutionary in *On the Eve,* and Bazarov were the most significant of Rakhmetov's immediate, but inferior, predecessors. While this type of character was evolving in Russian literature, in radical criticism his creation was being demanded by Chernyshevsky as early as 1856 and Dobrolyubov in 1859-1861. These two trends came together and culminated in Rakhmetov. He was the most powerful representation of the type. He was the dedicated, professional revolutionary embracing the needed amounts of commitment fused with life and enlightened egoism, all underscored by an ingrained love for mankind. And he was a true Russian hero whose roots, contrary to the opinion of some

[7] *Ibid.*, pp. 518-519.
[8] *Ibid.*, p. 519.

critics,[9] were anchored deep in Russian culture. The most important real life model for Rakhmetov was probably Bakunin; the physical and temperamental similarities are especially striking. Yet, in his intellectual make-up, naturally, Rakhmetov very closely reflected his creator. It was Pisarev who probably summarized Rakhmetov best:

> In his wish to give his readers convincing proof that Lopukhov, Kirsanov, and Vera were really ordinary people, Chernyshevsky brings into action the titanic figure of Rakhmetov, whom he himself acknowledges as extraordinary and calls "a special kind of man." Rakhmetov has no part in the development of the novel, and there is really nothing he can do about it; people like him are in their sphere and in their place only where and when they can be historic figures; for them individual life itself is cramped and petty; they get no satisfaction from science or from domestic happiness; they love all people, suffer from every injustice that is committed, experience in their own soul the great sorrow of millions, and sacrifice all they can to relieve that sorrow. . . . they remain in their own country and influence those around them. . . . They see the present is bad, they endeavor to make the future better and they apply to the work whatever means they have at hand. . . . Never since the creation of the world have these people made a career for themselves. . . .[10]

Whereas dedicated disciples like Pisarev saw Chernyshevsky as epitomizing the true artist, others who were less directly concerned accuse Chernyshevsky of writing here on such a low imaginative level as to violate his own principal aesthetic standard of realism. *What Is To Be Done?* was also criticized for lacking the concreteness for which Chernyshevsky was

[9]For example, one of these literary commentators hold that Rakhmetov's creation reflects the profound influence of French rationalist thought on Chernyshevsky, but this reviewer neglects to provide any meaningful evidence to support his assertion. And neither does Chernyshevsky offer direct substantiation for this interpretation. See: R. W. Mathewson, Jr., "The Hero and Society: The Literary Definitions (1855-1865, 1934-1939)," *Continuity and Change in Russian and Soviet Thought*, ed. by E. J. Simmons (Cambridge, Mass.: Harvard University Press, 1955), pp. 261-264.

[10]D. L. Pisarev, *Selected Philosophical, Social, and Political Essays*, ed. and trans. by R. Dixon and J. Katzer (Moscow: Foreign Languages Publishing House, 1958), pp. 668-669.

otherwise noted. Among the numerous controversial aspects of the work, "the new people," especially Rakhmetov, far and away created the greatest stir. The reasons were both of an artistic and political nature. The majority of the reviewers' preponderant criticism was that these characters were simply unreal and stereotypically unindividualistic; in turn, they were placed in unnatural situations and, once there, were guilty of explaining their own actions. The home life and activities of the Lopukhovs and the adventures of Rakhmetov were examples which were cited over and over again. On a different plain, the radical posture, as exemplified by Rakhmetov and Dimitry, and the revolutionary phenomena, such as Vera's workshop, presented by Chernyshevsky, if accepted as possible, could have proven a threat to the established order. Thus, much of the immediate so-called "artistic criticism" launched against *What Is To Be Done?* in actuality was carefully cloaked and voiced political opposition founded upon the real fear that, if believed, Chernyshevsky's "dreams" could be realized.[11] Oppugnant ideological camps often employ similar tactics.

No more than a few of these commentators even began to see the feasibility of "the new people," still less recognized their distinct, human attributes. Rakhmetov, the self-disciplined and tireless revolutionary giant, had an undefeatable craving for expensive, imported cigars which he did not hesitate to satisfy. The chief difference between these characters and some others in Russian literature was that Chernyshevsky had given his personages magnitude and direction by committing them to the service of their fellow man.

Although perfectly viable as a type, all of Chernyshevsky's "new people" displayed shades of unreality at one point or another, a not too uncommon occurrence among fictional characters. And, perhaps, the most shadowy of the breed was Rakhmetov. Chernyshevsky's literary prowess, especially his character delineation, could not be compared to that of Dos-

[11]Dostoevsky was especially disturbed by the figure of Rakhmetov and all which he represented. Raskolnikov, the main character of *Crime and Punishment*, which was published in 1866, was Dostoevsky's answer; with Raskolnikov his creator attempted to show what could happen when a "new man" went awry. Dostoevsky took Chernyshevsky's hero and made of him an anti-hero.

toevsky or Tolstoy. Nevertheless, even Chernyshevsky's most ardent critics did not fail to indicate that he was dealing with a new strain of man which was yet possibly to appear. Chernyshevsky was far from correct in his predictions on the immediacy of the revolution and the form it would take in Russia. It was also quite conceivable that he could have made similar mistakes about the revolutionary leadership. However, was he not at least partially vindicated by the coming of actual individuals, first like Tkachev, and then Lenin, who were themselves inspired by Chernyshevsky's creations?

What Is To Be Done? had a substantial impact on future generations of Russian radicals, Marxist and non-Marxist alike. Among Chernyshevsky's more youthful readers the reaction was very similar to what had taken place in Germany among Goethe's teen-age followers upon the appearance of *Die Leiden des Jungen Werthers* (*The Sorrows of Young Werther*) in 1774. These young Russians began to emulate Chernyshevsky's "new people" in their dress, their speech, and their actions. Rakhmetov and Vera were clearly the favorites and served as the principal models. With all the energy of youth at their disposal these disciples set out to further the progress of their people, the Russian people, and to bring about the realization of the visions presented by Chernyshevsky. Many a *narodnik* drew his inspiration from the works of Chernyshevsky.

Chernyshevsky had a profound influence upon many of the founders of Russian Marxism, the Soviet state, and its art.[12] Georgii V. Plekhanov, the father of Russian Marxism and founder of Menshevism, was among the first of the Marxists to comment extensively on *What Is To Be Done?*. Of this novel he once said:

> Who has not read this work over and over? Who has not become captivated by it, who has not become purer and more courageous because of its beneficial influence? Who has not impersonated its saintly principal per-

[12]The Soviet cult of the hero has most of its major roots in the literature and criticism of the nineteenth century. Thus, characters like Sholokov's worker-hero Davidov in *Virgin Soil Upturned* (1932), Pavel Korchagin in Ostrovsky's *The Making of a Hero* (1937), and Strelnikov in Pasternak's *Doctor Zhivago* (1957), among others, can be considered the direct, somewhat weaker, descendents of Rakhmetov.

> sonages. Who, upon reading this novel, has not re-examined himself? From it we all draw moral strength and faith for a better future.[13]

Many of the Bolshevik heirarchy—Lenin, Trotsky, Lunacharsky, and Stalin among them—derived significant career incentives from Chernyshevsky's "new people." Lenin said that he had been taught ". . . what the revolutionary must be like, what his rules must be, how he must go about attaining his goals, and by what methods and means he can bring about their realization."[14] And Georgii Dimitrov, the Bulgarian Communist leader, Comintern chairman, and an associate of both Lenin and Stalin, pointed to Rakhmetov as the foremost spur to his own progress as a revolutionary figure:

> It must be said . . . that there was no literary work which was so strongly influential on my revolutionary career as Chernyshevsky's novel. For months I lived the life of Chernyshevsky's heroic figures. Rakhmetov was my principal favorite. I set a goal for myself of being as strong, self-disciplined, to moderate my will and character in my struggle with hardship and depravity, to subjugate my personal existence to the interests of the great proletarian cause — just like this magnificent hero of Chernyshevsky.[15]

In *What Is To Be Done*? Chernyshevsky envisioned the onset of a "new world," a utopia, the product of a sweeping social cataclysm. While he presented a few glimpses of what this future civilization could be like, his major interest was not in the final outcome of the struggle, but in the struggle itself. Thus, the "new people" were not representative of the citizenry of the "new world," but rather they were among those in-

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[13]This passage is recorded by N. Vodovozov in an editor's postscript to one of the numerous Soviet editions of *What Is To Be Done?* (Moscow: 1947), p. 464.

[14]This quote is from a document that bears Lenin's answer to a question put to him in 1904 concerning the influences on his career as a revolutionary before Marx. See: N. Valentinov [N. V. Volski], *The Early Years of Lenin*, ed. and trans. by R. H. W. Theen, intro. by B. D. Wolfe (Ann Arbor: The University of Michigan Press, 1969), pp. 194-196. To my knowledge, Valentinov is the only one to ever have published this amazing statement.

[15]This quote is from the forward of an extremely rare impression of *What Is To Be Done?*, edited by Dimitrov, published in 1935. The passage is also cited by Vodovozov (p. 470) in the editor's postscript to his edition of the novel.

dividuals responsible for its formation. Nowhere was this more evident than with Rakhmetov. In a revolutionary environment he was a messianic colossus, but in a utopia there would be no place for him or his kind. Rakhmetov was the ideal embodiment of Chernyshevsky's elemental revolutionary ethic and, as intended, served as a prototype for those persons who actually engaged in initiating and carrying out the changes.

THE DEVELOPMENT AND USE OF PRODUCTION FUNCTIONS IN ECONOMIC RESEARCH

NEIL B. MILLS

Development

Production functions are mathematical expressions of the functional relationship between output and one or more inputs. The term "production function" is synonymous with the term "input-output realtionship," and is used more by mathematicians and statisticians while the latter is used by economists.[1] The recognition of this relationship is not new. In fact, Adam Smith was aware that output must be credited to land and capital, as well as labor, when he wrote: "In this state of things, the whole produce of labour does not always belong to the labourer. He must in most cases share it with the owner of the stock which employs him."[2]

While many of the early economists suggested hypotheses concerning production processes, research relating to input-output relationships was not identified until 1855 when Justus von Liebig promulgated his "law of the minimum."[3] However, it remained for Knut Wicksell, founder of the "Swedish School" of economic theory, to design the first recognized production function. Probably because of his better known theories on price and capital, Wicksell's production function attracted little attention.

In fact, Wicksell himself did not discuss it in detail when he explained it in his doctoral dissertation, "Finanztheorische Untersuchungen" (Studies in Finance Theory), at the University of Uppsala in 1896. He did theorize that the productivity of an individual laborer could be specified algebrically as $p = ch^m t^k b^v$ where m, k, and v are the appropriate coefficients, c is a constant, h is units of land, and t and b are the lengths of the investment periods of labor and lands respectively.[4]

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[1]Earl O. Heady, *Economics of Agricultural Production and Resource Use* (Englewood Cliffs, N. J.: Prentice Hall, Inc., 1960), p. 29.
[2]Adam Smith, *The Wealth of Nations*, Edwin Cannan editor (New York, N. Y.: Random House, Inc., 1937), p. 49.
[3]Earl O. Heady and John L. Dillon, *Agricultural Production Functions* (Ames, Iowa: Iowa State University Press, 1961), p. 10.
[4]George J. Stigler, *Production and Distribution Theories* (New York, N. Y.: The MacMillan Company, 1941), p. 295.

In 1909, R. Mitscherlich suggested a non-linear production function that was linear in logarithms to define the algebraic nature of the fertilizer-crop relationship. In 1923, W. J. Spillman patterned his well known function after that of Mitscherlich. The Spillman function was expressed as $Y = M - AR^x$ where M is the maximum total yield from increasing nutrient input x, and A is a constant defining the maximum response (the sum of the marginal yields) that can be obtained as a result of increased applications of x.[5]

One of the first major attempts by economists to fit a production function to empirical data was sponsored by the U.S. Department of Agriculture in 1924. Although regression equations were not always computed, such inputs as labor, fertilizer, and feed were analyzed. A production function for hog raising was fitted and it showed diminishing marginal productivity.[6]

The Cobb-Douglas production function was introduced in March 1928 as a statistical test of the theory of marginal productivity.[7] The idea of mathematically expressing this input-output relationship was conceived by Professor Paul Douglas of the University of Illinois. But, Dr. Douglas was an economist who required mathematical assistance. So, when he felt that it was possible to design a production function that would express the relationship between product, labor, and capital, he called in his friend, Professor Charles W. Cobb of Amherst College, in the spring of 1927. Using the Douglas concept, Dr. Cobb proceeded to develop the formula, find the constants, and conduct the mathematical analyses of the various studies to follow.[8]

The Cobb-Douglas function, as it was to become known, was essentially the same as that of Knut Wicksell. It was expressed as $P' = bL^kC^{1-k}$ where P′ was the predicted index of manufacturing output during the period, L was the index of employment in

[5]Heady and Dillon, *op. cit.*, p. 11.

[6]H. R. Tolley, J. D. Black, and M. J. B. Ezekiel, *Input as Related to Output in Farm Organization and Cost of Production Studies*, U. S. Department of Agriculture Technical Bulletin 1277 (Washington, D. C.: U. S. Government Printing Office, 1924).

[7]Charles W. Cobb and Paul H. Douglas, "A Theory of Production," *American Economic Review*, Volume 18 (March Supplement, 1928), pp. 139-165.

[8]Paul H. Douglas, *Theory of Wages* (New York, N. Y.: Kelley and Millman, 1934), pp. 132-133.

manufacturing industries, C was the index of fixed capital in industry, b was a constant, k was the marginal productivity of labor, and 1-k was the (residual) marginal productivity of capital.[9]

In their initial research with their newly developed production function, Cobb and Douglas studied the increase in manufacturing during the period 1899–1922. They fitted the production function $P' = 1.01L^{.75}C^{.25}$ and found that their estimates for total output were remarkably close to actual total output. They did not claim to have solved the law of production, but they were convinced that they had devised an effective method of approximation. Professors Cobb and Douglas admitted that their theory was developed from the movement of labor, capital, production, values, and wages for the manufacturing industries of the country as a whole. But, they saw the possibility of applying this approach to such other areas as agriculture, mining, transportation, and public utilities. They also suggested that further research should be conducted to investigate the possibility of including land as an independent variable.[10]

A total of four studies were made by Cobb and Douglas using their original production function. All were time series for industries, and the results were as follows:[11]

Area	*k*	*1-k*
United States (1899–1922)	.75	.25
Massachusetts (1890–1926)	.74	.26
Victoria, Australia (1907–1929)	.71	.29
New South Wales, Australia (1901–1927)	.65	.35

The original Cobb-Douglas production function became a valuable instrument in analyzing income distribution, and went far in explaining the apparent stability in the income shares of capital and labor.[12] It is now obvious that, since 1900, wages and productivity have risen together with little change in the relative shares of labor and capital. This phenomenom is called "Bowley's Law" in recognition of the late Sir Arthur Bowley of the

[9]Heady and Dillon, *op. cit.*, pp. 16-17.
[10]Cobb and Douglas, *op. cit.*, pp. 164-165.
[11]Paul H. Douglas and Grace T. Gunn, "The Production Function for American Manufacturing in 1919," *American Economic Review*, Volume 31 (March 1941), p. 69.

London School of Economics who noted the constancy of wages' share of National Income over almost a century.[13]

Professor Douglas later recognized many of the limitations of the Cobb-Douglas function. He was aware that cross-sectional data from a group of industries might not be applicable to individual firms. Also, the function did not provide for qualitative differences in labor and capital, and labor was measured in units employed while capital was measured in units available for employment. Finally, the data upon which the fits were based were of suspicious accuracy, and the time series research did not account for population growth and technological advances.[14]

Of all the criticisms leveled at the Cobb-Douglas function, the most serious were directed at the restriction for the coefficients to sum to 1.0, thereby ignoring the possibilities of either increasing or decreasing returns to scale. At the urging of David Durand, the Cobb-Douglas function was modified in 1937 to the form $P = bL^kC^j$, where k and j could be any value and need not necessarily total 1.0. In addition to recommending the more realistic coefficients, Durand suggested that there were factors in addition to labor and capital that contributed to production and should therefore be considered.[15]

Early Applications

The first empirical estimates of the modified Cobb-Douglas function were accomplished by Dr. Earl O. Heady in 1939. Heady used a sample of 738 Iowa farms, stratified according to type of farm and for area of farming. Some of the elasticities of production were negative, but none of these was statistically significant at the .05 level of probability. The sum of these

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[13]Marrin Frankel, "The Production Function in Allocation and Growth: A Synthesis," *American Economic Review*, Volume 50 (December 1962), p. 995.

[14]Paul A. Samuelson, *Economics: An Introductory Analysis*, seventh edition (New York, N. Y.: McGraw-Hill Book Company, 1969), pp. 717-719.

[14]M. Bronfenbrenner and Paul H. Douglas, "Cross-Section Studies in the Cobb-Douglas Function", *Journal of Farm Economics*, Volume 47 (December 1939), pp. 777-778.

[15]David Durand, "Some Thoughts on Marginal Productivity with Special Reference to Professor Douglas' Analysis", *Journal of Political Economy*, Volume 45 (December 1937), p. 755.

elasticities was less than one, indicating decreasing returns to scale.[16]

Another early empirical application of the Cobb-Douglas production function to attempt a comprehensive inclusion of independent variables was by Tintner and Brownlee. They disaggregated a sample of 468 Iowa farm records for 1939 into five groups according to the type of farm—dairy, hogs, beef feeders, crops, and general agriculture. Input variables used were land in acres (A), months of labor (B), farm improvements such as buildings and fences (C), liquid assets such as livestock, feed, and seed (D), working assets such as machinery and breeding stock (E), and cash operating expenses such as repairs, fuel, and fertilizers (F). Management was intentionally excluded as an input because there was no acceptable unit by which to measure it. For all farms, about 74 percent of the variation in the dependent variable (gross profits) was explained by the factors included in the analysis.[17] Tintner used this same technique again to fit a production function to cross-sectional data obtained from 609 Iowa farm records for 1942. He favored the use of a Cobb-Douglas type production function for three reasons: (1) it gave immediate elasticities of production for the inputs; (2) it permitted decreasing marginal returns without using too many degrees of freedom; and, (3) assuming that the errors were small and normally distributed, logarithmic transformation of the variables would preserve that normality to a substantial degree while permitting the best linear estimate by the method of least squares.[18]

Characteristics

Since World War II, there have been considerable research and empirical applications of production functions to input-out-

[16]Earl O. Heady, "Production Function From a Random Sample of Farms", *Journal of Farm Economics,* Volume 28 (November 1946), pp. 989-1009.

[17]Gerhard Tintner and O. H. Brownlee, "Production Functions Derived From Farm Records", *Journal of Farm Economics,* Volume 26 (August 1944) pp. 566-567.

[18]Gerhard Tintner, "A Note on the Derivation of Production Functions From the Farm Records," *Econometrica,* Volume 12 (January 1944), pp. 26-34.

put relationships in agriculture.[19] Dr. Griliches of the University of Chicago has divided the work accomplished with production functions into two major categories. First, he states, economists use these mathematical expressions with experimental data and a few well defined inputs to determine optimum resource combinations. The results of this research is used to advise farmers. Second, economists use production functions like the Cobb-Douglas with actual data and several poorly defined inputs. This type of research is used to analyze relative productivity of resources, to diagnose various disequilibria, to search for evidence of economies of scale, and to prescribe improved input patterns of specific classes of farms.[20]

Production functions may also be categorized according to the specification of the output. If the production function is used to estimate output for a single product (i.e., milk), it is called a microfunction. If the dependent variable is an aggregation of various outputs (i.e., gross income, total product), the production function is called a macrofunction.[21]

Dr. Heady of Iowa State University believes that, regardless of definition, input-output relationships are at least the partial basis for most recommendations by economists. He further believes that the function most frequently used is of the Cobb-Douglas type. This is because of the intrinsic economy in degrees of freedom, making possible regression coefficients that are significant at conventional probability levels.[22]

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[19]For a summary and description of several applications of production functions, primarily to agricultural production in Iowa, see Earl O. Heady, "An Econometric Investigation of the Technology of Agricultural Production Functions", *Econometrica,* Volume 25 (April 1957), pp. 149-268.

[20]Zvi Griliches, "Review of Agricultural Productions Functions", *American Economic Review,* Volume 52 (March 1962), p. 281.

[21]For a discussion of this and other characteristics of production functions, see Yair Mundlak, "Specification and Estimation of Multiproduct Production Functions", *Journal of Farm Economics,* Volume 45 (May 1963), pp. 433-445.

[22]For an expanded discussion of this subject, see Earl O. Heady, "Organization Activities and Criteria in Obtaining and Fitting Technical Production Functions", *Journal of Farm Economics,* Volume 39 (May 1957), pp. 360-369; and, Earl O. Heady, "Use and Estimation of Input-Output Relationships or Productivity Coefficients", *Journal of Farm Economics,* Volume 34 (December 1952), pp. 775-786.

The Cobb-Douglas type of production function, as it is presently applied, can accommodate multiple independent variables. For instance, a typical Cobb-Douglas function with four inputs may be expressed as: $Y = aF_1^{b1}F_2^{b2}F_3^{b3}F_4^{b4}$. If b_1 is less than 1.0 an increase in F_1 will result in diminishing returns to that factor. For b_1 values equal to or greater than 1.0, constant or increasing returns respectively exist for F_1. The sum of the exponents (b_1, b_2, b_3, b_4), also called elasticities of production, determines the nature of return to scale. If this sum is equal to 1.0, there are constant returns to scale; and, if it is more than 1.0, there are increasing returns to scale.[23]

In spite of the wide acceptance of the production function as a research tool, several economists have been quick to point out its limitations and its misuse. Hildebrand, for example, stated that it would be possible to design a model to support almost any recommendation concerning resource use. He also pointed out that year to year statistical estimates reflect variations in prices and output, and that the results of estimates using a Cobb-Douglas function must be used with caution.[24] This dynamic nature of production has been previously explained by Dr. Schultz of the University of Chicago as the result of new techniques. To illustrate his view, he pointed out that from 1910–1950, in the United States, agricultural output per unit of input increased on the average at least 0.8 percent per year, and at times it increased as much as 1.35 percent per year.[25] Considering this, perhaps "new techniques" should be included as a constant or an independent variable when designing production functions.

According to Dr. Griliches, the basic problem is interpreting the results of fitting production functions with empirical agricultural data is the specification of the model that generated the data. If different farmers have different situations, pay different prices, and use different resource combinations, they actually

[23]Earl O. Heady, G. L. Johnson, and L. S. Hardin (editors), *Resource Productivity, Returns to Scale, and Farm Size* (Ames, Iowa: Iowa State College Press, 1956), pp. 88-89.

[24]John R. Hildebrand, "Some Difficulties With Empirical Results From Whole-Farm Cobb-Douglas Type Production Functions", *Journal of Farm Economics,* Volume 42 (November 1960), pp. 902-904.

[25]Theodore W. Schultz, *Economic Organization of Agriculture* (New York, N. Y.: McGraw-Hill Book Company, 1953), pp. 109-110.

have different production functions. So, says Griliches, it is impossible to draw any "structural" conclusions from non-experimental data.[26] This is the problem of "hybridity" which has been recognized by every economist who has worked with production functions. A production function so structured from cross-sectional data is really an average function that is supposedly representative of the group from whose data it was constructed. So, this average production function, derived from cross-section survey data by least-squares curvefitting, is a composite of data from one point only on each of a number of different production functions. But, applying this average production function to an individual farm to criticize allocation and combination of resources must be done with care. What is right "on the average" for a group is not necessarily right for a specific enterprise.[27]

The problem of hybridity in constructing a production function results from aggregating heterogeneous data into a single variable which is then treated as having a homogeneous composition. An interfirm production function constructed of aggregative variables is a legitimate theoretical tool for estimating various facets of production for the group or area from which the sample was taken. But, the use of an interfirm production function is not always appropriate to specify an input-output relationship for an individual enterprise. For instance, the resource combination for a dairy farm would be quite different from that of a beef farm, even though data from both were included in the sample.[28]

The foregoing is not intended to denigrate the use of production functions, but only to stress the importance of appropriate application when interfirm variables are aggregated. As an illustration, one agricultural research project required the aggregation of variables from twenty two countries, overcoming problems of measurements in different units and the heterogeniety of

[26]Griliches, *op. cit.*, pp. 282-283.

[27]C. S. Soper, "Production Functions and Cross-Section Surveys", *The Economic Record*, Volume 34 (April 1958), p. 117.

[28]A more comprehensive discussion of this problem is available from George C. Judge, "Discussion: Estimates of the Aggregate Agricultural Production Function From Cross-Sectional Data", *Journal of Farm Economics*, Volume 45 (May 1963), pp. 429-432; and M. Bronfenbrenner, "Production Functions: Cobb-Douglas, Interfirm, Intrafirm", *Econometrica*, Volume 12 (January 1944), pp. 35-44.

composition of farms and variables, in order to construct an international production function for agriculture. This was correctly used to compare the world's agricultural production rate with the increase in the world's population.[29]

In agricultural research, the problems of aggregation can be at least partially overcome by careful selection of the sample. Dr. Heady suggests that interfarm production functions do have intrafarm applicability if the sample is appropriately stratified to avoid heterogeneity.[30] It also has been noted that the solution of the aggregation problem invariably involves a compromise between handling large volumes of data and the loss of relevant detail. The seriousness of this problem depends upon the level of aggregation, the purpose of the study, and the required precision of the findings.[31]

In estimating production functions, the possibility of bias should not be overlooked. If a relevant variable which is uncorrelated with the other independent variables is omitted, the omission will not necessarily bias the estimates of the included variables. But, the estimate of the returns to scale will be biased downward by an amount equal to the coefficient of production of the excluded variable.[32] There are at least two other properties of Cobb-Douglas type production functions that are considered unduly limiting. First, the elasticity of substitution is necessarily equal to unity. This characteristic has been used as an explanation of the apparent stability of labor's share of Net National Product. Second, both capital and labor must be used in production. In today's world of innovations and new techniques, the extremes of the fully automated firm (using no labor) and the use of labor without capital should not be regarded as impossible.[33]

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[29]Jyoti P. Bhattacharjee, "Resource Use and Productivity in World Agriculture", *Journal of Farm Economics,* Volume 37 (February 1955), pp. 57-71.

[30]Heady, "Use and Estimate . . . . . ," *op. cit.,* p. 782.

[31]Lee Day, "Theories in Aggregate Analysis — Discussion", *Journal of Farm Economics,* Volume 34 (December 1952), p. 795.

[32]For additional information on this subject, see Zvi Griliches, "Specification Bias in Estimates of Production Functions", *Journal of Farm Economics,* Volume 39 (February 1957), pp. 10-11.

[33]Frankel, *op. cit.,* p. 1016.

While the problems discussed limit the applications of Cobb-Douglas type production functions, alternative functions and procedures have experienced the same difficulties. And, many of these problems can be avoided, even though the production function is developed from interfirm data for later intrafirm application. If the different firms in the sample use essentially the same techniques of production and produce the same products, the intrafirm production function should approximate the production functions derived from the interfirm data. Heterogeneity can be avoided or limited by careful selection of the sample firms, systematic aggregation, and judicious use of derived data to see that it is equally applied to similar firms.[34]

Contemporary Design

The selection and specification of the variables are probably the most important steps in the initial design of a production function. Traditionally, output has been estimated as a function of the classical inputs—land, labor, and capital—expressed in varying levels of disaggregation and measured in a variety of units. However, this approach has been criticized by several economists. Notable among these critics is Dr. Schultz, who says that output changes cannot be satisfactorily explained by an analysis based upon conventional inputs. He goes so far as to say that these methods have contributed to our (U.S.) agricultural surpluses and to the food deficiencies in the underdeveloped countries. Some of the stated reasons why changes in output may not always be calculated from changes in input are: (1) the division and specialization of labor can increase production; (2) improvements in the quality of people as productive agents can increase production; (3) advances in technology and improvements in methods can increase production; and, (4) diminishing returns are not applicable for additional inputs that cannot be reproduced.[35]

[34]J. S. Plaxico, "Problems of Factor-Product Aggregation in Cobb-Douglas Value Productivity Analysis", *Journal of Farm Economics,* Volume 37 (November 1955), p. 672.

[35]Theodore W. Schultz, "Reflections on Agricultural Production, Output, and Supply", *Journal of Farm Economics,* Volume 38 (August 1956), pp. 748-762.

There have been many attempts to satisfactorily measure and include management as an independent variable in the input-output relationship. One of the earliest experiments was by F. J. Reiss in his 1952 Ph.D. dissertation at the University of Illinois. However, he found that management as an input variable failed to be significant (at the .05 level) in determining gross sales. The production function was fitted as follows: $Y = 3.48X_1^{.272}X_2^{.143}X_3^{.138}X_4^{.143}X_5^{.059}X_6^{.190}X_7^{.228}$ with X_7 as the variable for management. It is interesting to note that, when management was included, the sum of the elasticities increased from 0.974 to 1.173, indicating increasing returns to scale when management was considered. However, the inclusion of management caused a decrease in the coefficients of elasticity of some of the other independent variables.[36]

Dr. Glenn L. Johnson of The Michigan State University has studied the effects of including management as an independent variable in agricultural production functions. He points out that some inputs are used in the production of managerial services (money and effort spent on training, education, and experience), and that not all managerial services are expended on production (i.e., those used for security, comfort, and enjoyment). Consequently, some managerial services are hopelessly buried within other inputs while other managerial services are not contributing anything whatsoever to output. Another problem may arise when attempting to separate managerial ability from the efficiency of the production function as they are likely to be highly intercorrelated. Dr. Johnson studied 34 purposely selected Kentucky farms and found that managerial capacity appeared to be evenly and randomly distributed. When he fitted a Cobb-Douglas type production function to these data, the unexplained residuals appeared to be related to subjectively assigned managerial ratings.[37] This was similar to the results of research conducted by Dr. Heady in 1946. In this study, management was not included because there was no objective measure available. However, Dr. Heady believed that the unexplained residuals might have been suitable as an indication of managerial performance.[38]

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[36]Earl O. Heady, G. L. Johnson, and L. S. Hardin (eds.), *op. cit.*
[37]*Ibid.*, pp. 16-23.
[38]Heady, "Production Function . . . . . ." *op. cit.*, p. 1003.

Although management has understandably attracted the most attention as an omitted input variable, it is only one of several that has not been included because it cannot be readily and accurately measured. Variables in this group include weather, technology, location, and the availability of inputs. Other variables that are both available and measurable have been excluded when their significance was in doubt. In considering the number of variables to include in a model, two opposing considerations should be weighed. First, in order to design a model that is useful for predictions, as many reliable variables as possible should be included. Second, and contrary to the foregoing, the costs in obtaining and manipulating the data tend to limit the included variable to the most essential. Compromising between these two extremes results in "selecting the best regression equation."[39] Obviously, a truly representative production function will reflect output as a function of every contributing input (with either a positive or a negative coefficient of production). However, for reasons of practicality, such comprehensive inclusion seldom occurs.

Computer Applications

The introduction of computers to economic research has greatly increased the applications of the Cobb-Douglas type production function because several variables can be easily manipulated. As mentioned earlier, a typical Cobb-Douglas function is a "multiplacative" model of the type: $Y = aF_1^{b1}F_2^{b2}F_3^{b3}F_4^{b4}U$, where F_1, F_2, F_3, and F_4 are independent variables and the residuals are represented by U. Because this model is "intrinsically linear," transformation from its non-linear form by taking logarithms to the base e enables its expression in the following linear model:[40]

[39]N. R. Draper and H. Smith, *Applied Regression Analysis* (New York, N. Y.: John Wiley & Sons, Inc., 1966), pp. 163-164.

[40]In the logarithmic transformation of variables in Cobb-Douglas type production functions, it is generally preferred to use the transcendental number, e = 2.7182818285, as a logarithmic base. These logarithms are natural, or Napierian, logarithms and are indicated by the abbreviation "In". So, "In X" means the natural logarithm of X. On the other hand, the abbreviation "log X" indicates a common, or Briggs, logarithm which is to the base 10. Many writers do not make this distinction, and care must be exercised to insure the proper interpretation. Comprehensive tables of natural logarithms are not as readily available as are those of common logarithms. However, if the common logarithm is available, the natural logarithm may be readily calculated by the following formula: In X = (In 10) (log X) = (2.30258509) (log X).

$$\ln Y = \ln a + b_1 \ln F_1 + b_2 \ln F_2 + b_3 \ln F_3 + b_4 \ln F_4 + \ln U.$$[41]

There are several computer assisted procedures by which linear production functions can be estimated using the classical least-squares regression techniques. Some of these procedures are: (1) all possible regressions; (2) backward elimination; (3) forward selection; (4) stepwise regression; (5) two variations of the four previous methods; and (6) stagewise regression.[42] The stepwise regression procedure is most commonly used because it is generally considered the best of the variable selection procedures mentioned above. The computer program is readily available, and operating instructions have been written for both second and third generation computers.

The stepwise regression involves the entry of the model's independent variables one at a time. At each step, the variable added has a higher partial correlation with the dependent variable than any of the unentered variables. Also, at each step, each variable that has been previously entered is reexamined in accordance with a predesignated F ratio. This enables the contribution of each variable to be repeatedly checked as the other variables are entered. Any variable which has lost it's statistical significance is then removed from the regression. After all independent variables have been examined, the stepwise regression procedure terminates, and the retained variables comprise the regression equation that best expresses their relationship to the dependent variable.[43]

Computing the marginal revenue productivity for each input into the production function is easily accomplished without further access to a computer. The data matrix of the transformed variables provides the geometric means which are used in the following equation: $MRP_i = (b_i)(\overline{X}_1) / (\overline{X}_i)$ where b_i is the regression coefficient of $\ln X_i$, $\overline{X}_i$ is the geometric mean of the independent variable, and $\overline{X}_1$ is the geometric mean of the dependent variable.

[41] N. R. Draper and H. Smith, *op. cit.*, p. 132.
[42] *Ibid.*, pp. 163-164.
[43] *Ibid.*, pp. 171-172.

Summary

Certainly, the development and use of production functions have proved their worth over the years. With the advent of computers, the Cobb-Douglas type production functions, in particular, have emerged as a convenient compromise between adequate fit of the data, computational feasibility, and sufficient degrees of freedom for statistical verification. Applications involving the use of fifteen to twenty variables are not uncommon in current input-output analysis. If the trend toward increased quantitative interpretation continues, so will the use of production functions in economic research.

THE EFFECTS OF ETHYL ALCOHOL ON CONDUCTION VELOCITY AND RESIDUAL LATENCY IN THE HUMAN ULNAR NERVE

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The effects of ethyl alcohol on the nervous system of a variety of animals and on humans have been extensively studied. Most of these studies have dealt with the effects of ethyl alcohol on complex functions, such as various performance tests in response to auditory and visual stimuli (8, 9, 10). Final response in these tests depends on an intricate sequence of events: sensory perception, mental recognition of the stimulus, choice of appropriate action, and actual motor performance. It has been well documented that any or all of these processes could be either stimulated or depressed by ethyl alcohol, depending upon the amount ingested, rate of intake, concentration of the drink, rate of absorption, body composition, and many other such individually varying factors (3, 5, 8, 9, 10, 13).

Varied and contradictory results have been obtained in these studies. Thus it has been suggested that to solve this problem the effects of ethyl alcohol should first be studied in terms of the most basic components of the nervous system: individual motor neurons and simple spinal reflex arcs. Also, since the majority of humans consume alcohol in very small amounts, laboratory investigators should consider quantity when studying the pharmacology of ethyl alcohol.

There have been several reported electrophysiological studies concerning the effects of ethyl alcohol on isolated areas of the nervous system (1, 6, 11). These have been concerned mainly with the electrical activity of the brain of various animals which in most cases were given massive near-lethal doses. The few studies utilizing electromyography dealt mainly with action potentials produced and neuromuscular transmission in isolated animal nerve and muscle preparations (1, 2, 7, 9). Most of these studies were also conducted using large doses.

In a review of literature, the first research which could be found investigating the effects of ethyl alcohol on basic neuronal components was a study by Low, Basmajian, and Lyons (12). They observed the effects of small quantities of alcohol on conduction velocity and residual latency of the ulnar nerve in healthy conscious human subjects. The results of this study were that ethyl alcohol, in doses of 1½ oz. and 4½ oz., had no significant effect on ulnar nerve conduction velocity of the five male and five female subjects. The reported averaged means of all nerve conduction velocity measurements of the ten subjects were 56.3±4.2 M/sec during the control period, 55.4±5.2 M/sec after drinking 1½ oz., and 56.2±3.4 M/sec after drinking 4½ oz.

Nerve conduction velocity is defined as the speed at which a nerve impulse travels. Nerve conduction velocity was obtained by stimulating the ulnar nerve first at the elbow and then at the wrist while recording action potentials of the abductor digiti minimi. The difference between these two latencies of response was determined, and divided by the distance between the two stimulation points.

Knowing the nerve conduction velocity and the distance between two points, the amount of time that it should take an impulse to travel from one point to the other can be calculated ($t = d/V$). In calculating the time it should take an impulse to reach a muscle, it has been found that this is always less than the measured latency. The difference between the time it should take and the time it does take has been designated as the residual latency. Theories have been postulated to explain the existence of residual latency: a slowing in the terminal fibers of the nerve, a delay at the neuromuscular junction, or both.

Results of the Low, Basmajian, and Lyons study showed the ingestion of ethyl alcohol decreased the residual latency, inversely to the blood-alcohol level. The reported averaged means of residual latency were 1.52±0.21 msec during the control period, decreasing to 1.32±0.27 msec after drinking 1½ oz., and further decreasing to 1.15±0.23 msec after drinking 4½ oz. This finding of decreased residual latency with no effect on nerve conduction velocity was unexpected.

PURPOSE

Ethyl alcohol has characteristically been classified pharmacologically as a depressant. The positive effects concluded by Low, Basmajian, and Lyons were totally unexpected. In view of these surprising results, the present study was undertaken to verify the observations of Low, Basmajian, and Lyons.

PROCEDURES

Methods: The subjects included eleven female volunteers, all of whom had experienced drinking ethyl alcohol at least once, but none of whom were immoderate drinkers. All testing was conducted in the Human Performance Laboratory, The University of Texas at Austin.

Motor latencies were obtained by stimulation of the left ulnar nerve first at a wrist site and then at an elbow site. Three recordings were made at each site during each measurement and then averaged. A fixed pair of recording surface electrodes was placed over the left abductor digiti minimi muscle with the cathode over the motor point and the anode placed more distally. A pair of stimulating electrodes was used at the wrist site and the elbow site. After obtaining motor latency control values, the stimulating electrode positions were carefully marked at both locations. Distances were measured between cathodes with a metric tape. A ground electrode was placed equidistant between the stimulating sites. Action potential spikes were transduced and displayed on a TECA B-2 Oscilloscope. The point at which the action potential left the baseline was determined by a time indicator, and the time between the stimulus, which appeared as an artifact on the oscilloscope and that point was calculated.

All measurements on all subjects were obtained sometime between 2 pm and 7 pm, but on different days. This time period was selected on the basis of recent findings by Wyrick and Duncan[1] in a reliability study of within day trends of motor latency and nerve conduction velocity. They tested subjects at morning, noon, and afternoon sessions and found a greater change in motor latency and nerve conduction velocity from

[1]In Publication, *The American Journal of Physical Medicine*, 1970.

morning to the two afternoon sessions than between the two afternoon sessions.

After control values were obtained the subject drank a measured dose of alcohol. The amount, which was determined by body weight, was different for each subject so that all subjects would reach approximately the same blood-alcohol concentration level. The blood-alcohol concentration level chosen for this study was 0.05 per cent.

The weight range for the eleven subjects was from 115 pounds to 165 pounds. The doses, therefore, ranged from 2½ oz. to 3¼ oz. The alcohol was mixed with an equal amount of water. This was done to minimize the possibility of any subject becoming ill, and also because in normal situations people usually do not drink alcohol neat. Each subject was allowed ten minutes in which to drink the measured dose.

Following the administration of the alcohol, recordings were made at fifteen minute intervals for seventy-five minutes. Thus, one control value plus five experimental values were obtained. The subjects had not eaten during the previous three hours before the sessions and absorption should have been maximal within sixty minutes (3).

Treatment of Data:* Nerve conduction velocity and residual latency were computed from the elbow motor latency and wrist motor latency measures obtained. The four variables, elbow motor latency, wrist motor latency, nerve conduction velocity, and residual latency, were treated statistically, first by descriptive analysis. Means, standard deviations, and standard error of the means were computed for each variable on all six trials. The data were then subjected to treatment by analysis of variance to determine if there were real differences between the group means within each variable, and how significant any differences might be. Intraclass correlation coefficients were computed to determine variance estimates for within each subject on each variable and for between subjects on each variable. Trend analysis techniques were applied to determine whether any significant departure from linearity was random or showed

*Statistical services provided by Computer Center, The University of Texas at Austin.

sufficient regularity to suggest some type of systematic curvature which would explain a significant portion of the between means variance.

RESULTS

Means, standard deviations, and standard error of the means for all six trials of each variable are presented in Table I. As can be seen, the control values obtained for the four variables are in accord with normal values reported in the literature.

Wrist latency means decreased steadily in time, from 2.38± 0.29 msec to 2.09±0.16 msec forty-five minutes after drinking the alcohol dose. The means then began to increase. Residual latency means followed the same pattern, decreasing from a control value of 1.34±0.18 msec to 0.99±0.15 msec after forty-five minutes, then increasing. Means for elbow motor latency and nerve conduction velocity varied only slightly and showed no observable regular pattern.

Results of the analysis of variance treatment of the data are presented in Table II. Variances attributable to between trial means for the total group for wrist latency and residual latency were statistically significant (<.01). Variances attributable to between trial means for the total group for elbow latency and nerve conduction velocity were not significant.

Intraclass correlation coefficients for the four variables were determined to estimate the variance attributable to within subject variance on the trials (RI) and that attributable to between subject variance (RA). Results are presented in Table III. Within subject variability was rather unstable in all four variables, but between subject stability was sufficiently high except for residual latency. This might be expected since residual latency is determined by a difference between two correlated scores. If there is high correlation between two variables, this tends to lead to unreliable difference scores.

TABLE I

MEANS, STANDARD DEVIATIONS, AND STANDARD ERROR OF THE MEANS FOR WRIST LATENCY, ELBOW LATENCY, NERVE CONDUCTION VELOCITY AND RESIDUAL LATENCY

Variable	*Trial*	*Mean*	*SD*	*SE*
Wrist Latency	Control	2.38*	.29	.09
	15 min	2.26	.19	.06
	30 min	2.18	.19	.06
	45 min	2.09	.16	.05
	60 min	2.19	.18	.05
	75 min	2.27	.18	.05
Elbow Latency	Control	6.99*	.51	.15
	15 min	6.87	.43	.13
	30 min	6.91	.44	.13
	45 min	6.82	.37	.11
	60 min	6.97	.36	.11
	75 min	7.03	.31	.09
Nerve Conduction Velocity	Control	56.46**	4.09	1.24
	15 min	56.41	3.81	1.15
	30 min	55.31	4.40	1.33
	45 min	54.91	3.87	1.17
	60 min	54.42	4.03	1.21
	75 min	54.57	3.23	0.97
Residual Latency	Control	1.34	.18	.05
	15 min	1.23	.11	.03
	30 min	1.13	.15	.05
	45 min	0.99	.15	.05
	60 min	1.12	.23	.07
	75 min	1.22	.16	.05

N = 11
* milliseconds
** Meters per second

TABLE II

ANALYSIS OF VARIANCE

Variable	*Source*	*M.S.*	*D.F.*	*F-Ratio*	*P*
Wrist Latency	Total	.046	65		
	Between	.159	10		
	Trials	.105	5	6.06	.001
	Error (T)	.017	50		
Elbow Latency	Total	.159	65		
	Between	.756	10		
	Trials	.068	5	1.39	.244
	Error (T)	.049	50		
Nerve Conduction Velocity	Total	14.878	65		
	Between	67.770	10		
	Trials	8.917	5	1.82	.125
	Error (T)	4.896	50		
Residual Latency	Total	.038	65		
	Between	.061	10		
	Trials	.152	5	6.99	.001
	Error (T)	.021	50		

TABLE III

INTRACLASS CORRELATION COEFFICIENTS

Variable	*F*	*P*	*RI*	*RA*
Wrist Latency	6.30	.001	.469	.842
Elbow Latency	14.91	.001	.699	.933
Nerve Conduction Velocity	12.88	.001	.664	.922
Residual Latency	1.81	.079	.119	.448

An analysis of trends of the four variables was computed. The results are presented in Tables IV, V, VI, and VII. A quadratic equation best describes wrist latency, elbow latency, and residual latency. Nerve conduction velocity is best described by a linear equation.

DISCUSSION

The study of Low, Basmajian, and Lyons demonstrated that blood-alcohol levels up to 100 mg. per 100 ml. have no significant effect on ulnar nerve conduction velocity. Residual latency decreased inversely to the blood-alcohol level. The results of the present investigation are in complete agreement with the observations of Low, Basmajian, and Lyons. Nerve conduction velocity was not affected during the seventy-five minutes after drinking the alcohol. However, there was a significant decrease in residual latency, the greatest decrease being forty-five minutes after ingestion of the alcohol dosage.

From experimental evidence which has been obtained from animal work, these positive results of no effect on nerve conduction velocity and a decreased residual latency might have been anticipated. Gage (2) studied extensively the effects of ethyl alcohol on neuromuscular transmission in the rat. He concluded that alcohol had both a pre- and a post-synaptic effect and that the effect was increased as the alcohol amount was increased. The main response presynaptically was an increased transmitter (acetylcholine) release by a nerve impulse. Gage also found an increase in the sensitivity of postsynaptic receptors to the transmitter substance. This would tend to enhance neuromuscular transmission.

TABLE IV

TREND ANALYSIS OF WRIST LATENCY

Source	*M.S.*	*D.F.*	*F-Ratio*	*P*
Total	.046	65		
Within	0.25	55	6.06	.001
T	.105	5	3.62	.027
Linear	.109	1	12.08	.001
Quadratic	.372	1	.54	.827
Cubic	.006	1	.95	.531
Quartic	.010	1		
E(W)	.017	50		
Linear	.030	10		
Quadratic	.031	10		
Cubic	.012	10		
Quartic	.010	10		

TABLE V

TREND ANALYSIS OF ELBOW LATENCY

Source	*M.S.*	*D.F.*	*F-Ratio*	*P*
Total	.159	65		
Within	.051	55		
T	.068	5	1.38	.244
Linear	.029	1	.36	.938
Quadratic	.228	1	2.48	.084
Cubic	.002	1	.07	.999
Quartic	.001	1	.05	.999
E(W)	.049	50		
Linear	.081	10		
Quadratic	.092	10		
Cubic	.028	10		
Quartic	.025	10		

TABLE VI

TREND ANALYSIS OF NERVE CONDUCTION VELOCITY

Source	*M.S.*	*D.F.*	*F-Ratio*	*P*
Total	14.878	65		
Within	5.261	55		
T	8.917	5	1.82	.125
Linear	39.582	1	5.79	.006
Quadratic	1.578	1	.24	.984
Cubic	2.269	1	.57	.803
Quartic	.426	1	.14	.997
E(W)	4.896	50		
Linear	6.835	10		
Quadratic	6.708	10		
Cubic	3.951	10		
Quartic	2.991	10		

TABLE VII

TREND ANALYSIS OF RESIDUAL LATENCY

Source	*M.S.*	*D.F.*	*F-Ratio*	*P*
Total	.038	65		
Within	.034	55		
T	.152	5	6.99	.001
Linear	.183	1	6.57	.003
Quadratic	.486	1	12.68	.001
Cubic	.025	1	1.79	.186
Quartic	.022	1	1.17	.402
E(W)	.022	50		
Linear	.028	10		
Quadratic	.038	10		
Cubic	.014	10		
Quartic	.019	10		

Inque and Frank (7) observed the same results in studying the effects of ethyl alcohol on neuromuscular transmission in frog nerve-skeletal muscle preparations. They found that transmission was enhanced by ethyl alcohol both with presynaptic and postsynaptic actions.

Chronaxies have been measured in humans under the influence of alcohol. Generally, chronaxies showed an initial drop. Simple spinal reflexes tend to show an initial increase in speed. These two observations tend to become reversed as the alcohol concentration level is increased. As mentioned by Kalant (9) the initial improvements may be due not to direct action on nerve conduction velocity but to improvement of synaptic transmission. Information from recent experiments indicates that the synapse is probably the nervous structure most sensitive to alcohol (1). The results obtained by Low, Basmajian, and Lyons and by the present investigation concerning no effect on nerve conduction velocity would tend to substantiate this viewpoint.

In a review by Grenell (4) of studies observing narcotic or anesthetic effects of various levels of alcohol concentration, results obtained tended to suggest that narcotics in concentrations lower than those necessary to induce narcosis act to produce stimulation of neural structures. The investigator would like to postulate that application of the Arndt Law (poisons or toxins in massive doses destroy, in moderate doses inhibit, and in small doses stimulate) would appear feasible in explaining the positive effects of alcohol in low concentrations.

It should be emphasized at this point that the practicality of applying, in everyday circumstances, the two positive results obtained should be viewed with extreme caution. Humans do not drive cars, participate in sports, or do daily work with only synapses or simple spinal reflexes. When the brain becomes involved, which is in the great majority of cases, the total outcome is quite different.

It was the purpose of this study to verify basic information which may help lead to more exact knowledge concerning the total effect of alcohol on the human body.

SUMMARY AND CONCLUSIONS

Eleven female subjects were given ethyl alcohol dosages to produce approximately a 0.05 per cent blood-alcohol concentration level. Nerve conduction velocity and residual latency of the ulnar nerve were measured. The ingestion of the alcohol produced no significant effect on nerve conduction velocity of the ulnar nerve, but did significantly decrease the residual latency. Alcohol, in low concentrations, tends to act as a stimulant as far as basic motor neurons are concerned.

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JURGEN AND THE REPUTATION OF JAMES BRANCH CABELL

GEOFFREY MORLEY-MOWER

James Branch Cabell is not only an undeservedly neglected author, he is a widely misunderstood one. Edmund Wilson, among others, has protested against the neglect but has done nothing to clear up the misunderstanding which has often represented Cabell as an atheist, a blasphemer, and a pornographer.[1] The importance of setting straight the record is perhaps now greater than it has ever been, for there are signs of a Cabell revival on the way. Two of his books, *The Cream of the Jest* and *Beyond Life,* are being prepared for publication in America and three more, *Figures of Earth, The Silver Stallion,* and *Jurgen,* will be published in England during the next twelve months. At the 1968 and 1969 meetings of the Modern Language Association there were seminars on Cabell, which seems to indicate the interest of scholars in his work. There are now two Cabell societies and there is a quarterly magazine *Kalki,* published by one of them.[2]

In judging whether the revival of interest in Cabell is likely to be of any magnitude, the first question to consider might well be to what extent his neglect was brought about by external circumstances and how much can be attributed to defects in the works themselves. Wilson points to Cabell's occasionally precious and archaic diction and most critics would agree that many of his idiosyncracies are indefensible — for example, his habit of writing "not ever" rather than "never" and "a little by a little" instead of the more familiar usage. The faults, however, are outweighed by a multitude of virtues, and it is unlikely that a small amount of bad writing among a great deal of good could be responsible for his neglect. Since the late twenties, when his work went out of fashion, the intellectual and moral climate of the English-speaking world has been hostile, not only to his message—which can be summed

[1]Edmund Wilson, "The James Branch Cabell Case Reopened," *The Bit Between My Teeth* (New York: Farrar, Straus and Giroux, 1965).
[2]James Blish, "The Tolkien of the Twenties Return," *Book World,* July 6, 1969.

up as a civilized hesitancy before the existential realities—but also to the detached tone of his writing. At a period when the nations were being called to arms and, after 1945, held in a permanent crisis, the quiet and quizzical voice seemed inappropriate, the style merely mannered, the subject matter remote.

During the last decade, however, there have been changes in popular taste, favouring the fantastic and the philosophical, which could make Cabell of interest once again. J. R. Tolkien has become, through his books on the Hobbits, a race of little people living in the dawn of history, something of a cult figure for the young people both in Britain and America, and his books are to be seen in paperbacks in drug stores. There are sound reasons for Tolkien's popularity. The conflict between the western democracies and the Communist bloc has found its literary equivalent in Tolkien's war between the good Hobbits and the evil goblins and it is not surprising that his vogue has been more marked in America, where the burden of opposing Communist expansion is most felt and where the tendency to reduce complex political struggles to clear moral issues is most pronounced. However, the climate of opinion continues to change, no doubt due to the long duration of the Viet-Nam war. Among the youth we now have disillusionment with political parties, anti-war sentiment and a cynical attitude towards materialist values. Cabell has all of this, and in the past it has prejudiced readers against him. It may dispose them to him in the future.

Moreover, if allegorical works featuring imaginary kingdoms are in fashion again, Cabell, whom Edmund Wilson has compared to Flaubert and Swift, is Tolkien's literary superior and has a more complex product to purvey. "If we must read about imaginary kingdoms," Wilson writes, "give me James Branch Cabell. He at least wrote for grown-up people and he does not present the drama of life as a showdown between good people and goblins. He can cover more ground in an episode that lasts only three pages than Tolkien is able to in one of his twenty-page chapters and he can create a more dis-

quieting impression by reference to something that is never described than Tolkien through his whole demonology."[3]

Beginning with *Jurgen* in 1919, we come to what many critics consider his mature work. It was followed by the three books which have received most critical acclaim — *The High Place* (1923), *The Silver Stallion* (1926), and *Something About Eve* (1927). He went on to write other books over the next twenty-five years, but it is probable that posterity will consider the books mentioned above his major achievements.

Jurgen was his first book to be an outstanding commercial success and it is the only one of his books to have been printed in paperback. There is, however, a reluctance among critics to judge it his best book. Arvin Wells[4] and Joe Lee Davis,[5] both of whom have produced full length studies, are tentative in their value judgments on individual books. Wilson prefers *The High Place* to *Jurgen*.[6] Cabell himself objected to those who compared his other works unfavourably with *Jurgen* and insisted that all the 'Poictesme' books were chapters of one book and that the public "should select whatsoever chapter it may please them as the least inadequate chapter of my large book." Against such solid opposition it may be presumptuous to assert the superiority of *Jurgen,* but Cabell himself, while he was writing the book, certainly realized that something in the story had released an unaccustomed flood of creative energy.

He began it as a short story, but it soon wriggled out of its creator's grasp and demanded fuller treatment. Writing excitedly from Richmond, he announced to his friend Burton Rascoe that he intended "to make of this thing a book of noble and majestic proportions, though it involves the squandering of every idea I possess."[7] This was prophetic because *Jurgen* seems to express his central themes — particularly his ideas

[3]Edmund Wilson, "O, O Those Awful Orcs!" *The Bit Between My Teeth* (New York: Farrar, Straus and Giroux, 1965), p. 332.
[4]Arvin R. Wells, *Jesting Moses* (Gainesville: University of Florida Press, 1962).
[5]Joe Lee Davis, *James Branch Cabell* (New York: Twaine Publishing Inc., 1962).
[6]Edmund Wilson, "The James Branch Cabell Case Reopened," *op. cit.*, p. 313.
[7]Padraic Column (edit.), *Between Friends* (New York: Harcourt, Brace and World, Inc., 1962), p. 84.

on the nature of reality and the distortions of the romantic temperament — with greater clarity than in his other works. Moreover, the density of ironic incident, satire, humor, and passages of poetic prose is greater than he achieved elsewhere. The suppression of the book on a charge of pornography was in one respect fortunate in that it brought the book readers and cleared the ground for other writers who were similarly hemmed in by the prudish standards of the censors. In another respect it was unfortunate, for Cabell got the reputation of being a "pornographic" writer and lost many readers who might have sustained his reputation beyond the twenties.

Jurgen, whether or not it is Cabell's best book, is certainly one of his most typical and it contains all those features for which the author has been so liberally criticized. It begins with the central character, an ageing pawnbroker, who is also a poet, passing the Cistercian Abbey on his way home from his shop. He meets a monk, who has just stubbed his toe on a stone and is cursing the devil, and Jurgen ventures an elaborate and poetic defense of his Satanic majesty. He passes on and is approaching his home when he meets a black gentleman who thanks him for his good word. In conversation, Jurgen lets it out that his wife does not "quite understand him." When he reaches his home his wife is not found anywhere and, suspecting that it is the Prince of Darkness who has removed her, he resolves to "do the manly thing" and retrieve her. She has been seen by neighbors acting strangely near a cave outside the town, so, with some trepidation, Jurgen approaches the cave and enters.

Now the black gentleman is not Satan but a far more exalted figure, none other than Koschei the Deathless, who made things as they are, the Creator and Manager of the Universe, who obligingly dispatches Jurgen on a year-long romp, equipped with the loan of his youthful body in search of "justice" — which can be interpreted as a search for a meaning in life. The allegory is complicated, because while Jurgen ostensibly is searching for his crosspatch of a spouse he actually is seeking his fulfillment in one woman after another. Underneath the picaresque incident and the mountebankery of the central character it is an investigation of the nature of reality and

how, in the light of modern knowledge, a man of the western tradition should deal with the truths and untruths of religion, history, politics and popular philosophy.

Traveling through various mythological realms, he possesses Guinevere before her marriage to Arthur, lives with a nature goddess in Cocaigne, with a hamadryad in ancient Greece and with a vampire in hell. In spite of the farcical treatment of Jurgen's lovemaking he is, in these episodes, testing, in the most amusing and delicate way, various conventional systems of thought that have at one time or another captured the imagination of men.

Satirical elements bound. Hell is a democracy and Satan has been elected president and voted extraordinary powers for the duration of the war with heaven. There is a peace party and a vociferous war party bristling with infernal patriotism. Jurgen, whose nature it is to compromise with the Mammon of iniquity, particularly when his tenure is not sound, makes a long speech in council, satirizing a certain type of democratic politician who wishes to impose the utmost rigors of the law on all those whose patriotism is doubtful. It is a criticism of McCarthy before McCarthy — but performed in mock-medieval manner, with much display of invented authorities. Heaven is protected by a roof, lowered during wartime on earth to prevent the celestial ears from being offended by the blasphemous prayers for victory of the contending nations.

After ascending the throne of Almighty God but feeling uncomfortable there, Jurgen terminates his researches by returning to Amneran Heath, entering the cave there and asking Koschei for his old wife back again.

The central message of the book is that Jurgen — who stands allegorically for mankind, questing for satisfaction of its dreams and desires — finds nowhere what he is looking for. And, not in despair, but in a sort of humourous acceptance, he returns gratefully to the routine pieties and exasperations of ordinary existence. On one level it is a frustrated sortie of the human spirit. On another level it is an affirmation of religious values, for Jurgen rejects the nihilistic conclusion to his adventure. In a passage remarkable for its humour as

well as for the disquieting atmosphere to which Edmund Wilson has alluded — nihilism is tested and found wanting. The Brown man with queer feet (who is Pan), takes Jurgen into the darkness of a wood and there shows him "all." He exits from this experience shaken but defiantly argumentative.

> "Slay me, then!" says Jurgen with shut eyes, for he did not at all like the appearance of things. ". . . but it is beyond your power to make me believe that there is no justice anywhere or that I am unimportant . . . I am fettered by cowardice, I am enfeebled by disastrous memories; and I am maimed by old follies. Still, I seem to detect in myself something which is permanent and rather fine. Underneath everything, and in spite of everything, I really do seem to detect that something. What role that something is to enact after the death of my body, and upon what stage I cannot guess. When fortune knocks I shall open the door. Meanwhile I tell you candidly, you brown man, there is something in Jurgen far too admirable for any intelligent arbiter ever to fling into the dustheap . . . I believe I can contrive some trick to cheat oblivion when the need arises," says Jurgen, trembling, but, even so, with his mind quite made up about it.[8]

This does not place Cabell in the front rank of pious fideists, but it is a positive enough statement of belief in man's significance, which is at least the necessary basis for a religious attitude to life. It is not, moreover, contradicted by his more explicitly philosophical non-fiction works. In *Beyond Life* he defines man as "an ape, reft of his tail and grown rusty at climbing who yet . . . feels himself to be a symbol and a frail representative of omnipotence in a place that is not home."[9] Once again the philosophical statement is more poetical than philosophical and we may well ask where Cabell stands; but we will not get a clear answer from him, for he revels in the lack of clarity in his position and that of his various protagonists. His platform, if we may put it that way, is deliberately equivocal. What we do know is that he was not an unqualified sceptic and that he commonly attended divine service at

[8]James Branch Cabell, *Jurgen* (New York: Robert M. McBride & Co., 1927), pp. 125-6.

[9]James Branch Cabell, *Beyond Life* (New York: Robert M. McBride & Co., 1927), p. 201.

the Episcopal Church in Richmond. This does not locate the exact religious position of our luminary, but he shines nevertheless, however dubiously.

Arvin Wells has suggested that Cabell belonged to a group of thinkers, including Bertrand Russell, Unamuno, Hans Vaehinger and Santayana, who, while regretting the fact that Christianity was no longer believable, felt that it was necessary to go on behaving "as if" the moral universe of Christian ideals still existed.[10] I do not wish to claim philosophical originality for Cabell — it is sufficient to claim his imaginative originality — but it can be argued that he parted significantly from that group, in the direction of orthodox belief.

His criticism of Christianity is confined, for one thing, to its anthropomorphic manifestations. In *Quiet Please,* one of his latter books of reminiscences, he recalls that when he was young he always thought of God as "an elderly Jewish gentleman, addicted to wearing dressing gowns, who after the Crucifixion had joined the Catholic Church, and later had become an Episcopalian."[11] This comment is on a level with the satire on the "Heaven of Jurgen's Grandmother" and the imaginative version of hell conjured up by Coth of the Rocks; that is, it is not barbed with theological distaste, it is modified by humour and it makes fair comment on the history of Christianity. For example, in the interview with the Almighty God, who appears conventionally in a white beard, Jurgen protests no very strong faith in divinity but adds "you were loved by those whom I greatly loved a long while ago and it seems to me that dates and manuscripts and the opinion of learned persons are very trifling things besides what I remember and what I envy." And God says — brilliantly preserving the balance of the irony and the opacity of the central philosophy — "who could have expected such a monstrous clever fellow as you Jurgen ever to have envied the illusions of an old woman?"[12]

If Cabell can be defended against the charges of atheism and blasphemy, he can even more easily be acquitted of writing

[10]Wells, *op. cit.*, p. 13.

[11]James Branch Cabell, *Quiet Please* (Gainesville: University of Florida Press, 1952), p. 41.

[12]Cabell, *Jurgen, op. cit.*, p. 305.

pornography, though this last accusation has been the most persistent. When *Jurgen* first appeared his publishers were indicted before the Grand Jury of the County of New York for intending to "sell and show a lewd, lascivious, indecent, obscure and disgusting book entitled *Jurgen,* a more particular description of which said book would be offensive to this Court and improper to spread upon the records thereof, wherefore such description is not here given."[13] Commenting to Guy Holt January 17, 1920, Cabell protests that he "cannot find a sentence in the book that could not be read aloud in Sunday School."[14] This is perhaps to exaggerate his innocence but it can be doubted if his oblique and sophisticated treatment of sexual themes ever did have the force of phornography. They certainly do not today.

When Jurgen and Anaïtis come to the high grey walls of Cocaigne, the following conversation takes place:

> "You must knock two or three times," says Anaïtis, "to get into Cocaigne." Jurgen observed the bronze knocker upon the door, and he grinned in order to hide his embarrassment. "It is a quaint fancy," said he, "and the two constituents of it appear to have been modelled from life." "They were copied very exactly from Adam and Eve," says Anaïtis, "who were the first persons to open this gateway." "Why then," says Jurgen, "there is no earthly doubt that men degenerate, since here under my hand is the proof of it." With that he knocked, and the door opened and the two of them entered."[15]

The passage can, of course, be justified by its wit and its appropriateness to the realm of bodily pleasure. But the whole point of the Cocaigne episode is not to celebrate sensuality but to eliminate an exclusively sexual solution to the problems of human existence. This strictly moral tale would work equally well if applied to what has been called the Playboy philosophy or the modern drug scene. What Cabell is saying is that it is boring to become involved in the endless liturgies of sex (or drugs), but it is amusing enough to read about it.

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[13] *Between Friends, op. cit.,* p. 157.
[14] *Ibid.,* p. 158.
[15] Cabell, *Jurgen, op. cit.,* p. 146.

In his non-fiction works he continually complained of his unjustified reputation for lewdness and of his uncomprehending admirer, "the hordes of idiots and prurient fools and busybodies, of unpublished authors, well worthy of that condition, of dabblers in black magic, of catamites and of amateur strumpets."[16]

Cabell explicitly answers the New York Censors in the court scene in Philistia, when Jurgen is tried for lewdness. His accuser, an insect, demands his relegation to Limbo, "for he is offensive and lewd and lascivious and indecent" — the very words of the censor's indictment. The grounds of the charge are that Jurgen went through a sort of marriage ceremony with Queen Anaïtis in Cocaigne in which Jurgen carried a raised lance and broke with it a sacred veil. The symbolism is sexual but the passage is not pornographic, for Cabell describes nothing specific and the erotic imagination of the reader has nothing to hold on to. Jurgen, in his defense, replies that "these pages bear a sword and a lance and a staff, and nothing else whatever; and you deduce, I hope, that all the lewdness is in the insectival mind of him who itches to be calling these things by other names."[17] If the rather obvious joke can be forgiven, whereby the pages of Cabell's novel are also the pages of the court of Philistia who are holding the offensive weapons, the argument for the defense may seem cogent. Unfortunately mud sticks and no amount of argufying seems to remove it.

Carl Van Doren makes a contrast between Melville and Cabell, both so dominated in their different ways by a reaction to the Puritan code. But Cabell's wit, says Van Doren, is not so inhibited by religion as Melville's and plays "with conscience and immortality and blasphemy" (he might have added sexuality) without fear and "good humouredly strokes the beard of Jehovah."[18] It is not my intention to draw literary parallels but simply to note that Melville was accused of un-

[16]James Branch Cabell, *As I Remember It* (New York: The McBride & Co., 1955), p. 238.

[17]Cabell, *Jurgen, op. cit.*, p. 239.

[18]Carl Van Doren, *James Branch Cabell* (New York: Robert M. McBride & Co., 1928), p. 85.

orthodoxy and nameless moral faults, and his books died in his own lifetime only to be resurrected after his death. Cabell suffered a similar fate but the reasons for his eclipse of reputation are not so personal and much can be attributed to the drowning out of his singular, sly voice by the noise if international conflict. But unlike Melville, his literary reputation has not yet been restored, and a movement to bring him once more before a wide public is only beginning.

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PSYCHOLOGICAL DIVERGENCES IN THE PERCEPTION AND PERFORMANCE OF RHYTHM

MARION PERKINS

Experimental studies of perceptual miscalculations in the evaluation of time and intensity values is a fascinating subject for investigation as well as a research area of practical value to the musical performer. The conclusions drawn from the psychological data collected here may be useful in determining which modifications in the reproduction of musical rhythm might serve to counterbalance subjective deviations from the theoretical length of time values. Another object of this study is the application of experimental conclusions concerning the relation between intensity and temporal factors in the subjective perception of rhythm to concepts of rhythmical grouping.

Both the accentuation and temporal prolongation of a musical tone contribute to the definition of objective rhythmic groups; either of these factors may also play a role in the purely subjective organization of a series of uniform beats, but the accentual factor has the primary role in establishing the illusion of rhythmical units. The perception of stress in a series of unstressed sounds is subjectively read into the series, thus conveying the impression of rhythmical groups, the natural limits of which are equivalent to the relation between the tempo of the pulsation and the average span of attention of somewhat more than one second. These conclusions can be drawn from the experimental work of Thaddeus Bolton, the pioneer researcher in the field of subjective rhythmic perception.

> When the impressions are uniform in length and intensity, the mind enforces a grouping by giving fictitious values to the impressions, generally with respect to intensity, but sometimes with respect to duration. At the rate .795 sec., the mind intensifies every other sound, so that the series is grouped by two.

> The second sound in the group is subordinated to the first. At the rate of .460 sec., the mind finds it easy to group a series of auditory impressions by three, by intensifying the first greatly and the second slightly, so that the second is subordinated to the first and the third to the second. More than three degrees of intensity do not appear together in the order of their intensities in a series. In grouping by four, which takes place generally at the rate .307 sec., the mind accents the first strongly and the third slightly. The second and fourth impressions are generally of the same intensity. If there is any difference in intensity, the second is stronger than the fourth, but it is always less than the third or the first.[1]

We may conclude from these figures that the phenomenon of subjective accentuation apparently substantiates the validity of the metrical system of accentuation by its concurrence with the abstract intensity pattern of beats in the primary meters, although slight attention has seemingly been directed toward this correspondence.

Bolton's most important contribution to an understanding of rhythmic perception was his definition of the influence of intensity and duration upon rhythmic grouping. This has been further clarified by Herbert Woodrow. The basic idea is that a note of proportionately greater intensity tends to be perceived as beginning a group, while a note of proportionately greater duration creates the impression of ending a group. In Woodrow's study of the influence of pitch in grouping rhythmically, he gives this summary of the effect of these three factors as follows: "Intensity has a group-beginning effect: duration, a group-ending effect: pitch, neither a group-ending nor a group-beginning effect."[2] In regard to the factor of pitch then, Woodrow found no uniform tendency towards organizing an objective rhythmical group by means of pitch, although it should not be assumed from this that pitch is not an important factor in rhythmic organization.

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[1]Thaddeus Bolton, "Rhythm," *American Journal of Psychology,* VI (January 1894), 232-233.

[2]Herbert Woodrow, "The Role of Pitch in Rhythm," *Psychological Review,* XVIII (1911), 77.

In his study of the complex problem of the interrelation between the factors of duration and intensity in rhythmical grouping, Woodrow demonstrated the influence of apparent intensity on rhythmic grouping. Bolton had already discovered that a correlation existed between duraton and intensity, that is, his experiments showed that a long sound would frequently give the impression of greater stress to his subjects. Woodrow found that the effect of duration on the apparent intensity of a longer sound could cause the longer sound to create the illusion of beginning the group, but as the absolute duration of both sounds was increased, the group-ending tendency of the longer sound overtook the group-beginning tendency caused by the durational effect of apparent intensity.

> With sounds of very short absolute duration, this increase in apparent intensity as the result of an increase in duration is very great. Consequently, with sounds of short duration, if every second sound is two or three times longer than the others, it will seem louder; and if the intervals between the sounds are equal, the rhythm will be trochaic. With sounds of sufficiently great absolute duration, and of equal objective intensity, if every second sound is two or three times longer than the others, and the intervals between the sounds equal, the rhythm will be iambic. An intermediate duration can be found where the two effects cancel each other.[3]

In other words, Woodrow's experimental results indicate that the illusion of intensity created by the effect of duration on apparent intensity may be a decisive factor in the perceptive grouping of rhythmically organized sounds of very short absolute duration. Due to the factor of apparent intensity in conjunction with a short absolute durational value, a trochaic grouping may displace an iambic in the perceptive organization of a rhythmical series.

As duration can create an illusion of greater intensity, so may intensity have an effect on durational value. Experiments involving the perceptive organization of a uniformly spaced series of stressed and unstressed beats were conducted

[3] *Ibid.*, 56. This is a summary of discussion in *A Quantitative Study of Rhythm* (New York, 1909), pp. 64-65.

by MacDougall and Woodrow. The results indicate a psychological tendency to overestimate the time interval before a heavily accented beat and to underestimate the time interval following it. The subject is, of course, unaware that his impression of time values in relation to intensified sounds is at variance with the theoretical value of the sounds; the phenomenon is simply an auditory illusion.

The underestimation of the time interval following the stressed beat is a more consistent miscalculation than the overestimation of the interval preceding the beat, which is a more variable impression. MacDougall summarized the effect of intensity on apparent duration in the following statement:

> The influence of the introduction of such a louder sound, therefore, is to cause a decrease in the apparent duration of the interval which follows it, and an increase in that of the interval which precedes it. The illusion is more pronounced and invariable in the case of the interval following the louder sound than of that preceding it . . .[4]

On the basis of these psychological miscalculations, one could predict a tendency towards anticipation and prolongation of stressed beats in the reproduction of a beat pattern. And it has, in fact, been demonstrated that in the actual reproduction of a series of alternately stressed and unstressed beats, the durational value of the accented strokes is increased in approximate proportion to the amount of stress on the accented beats. The prolongation of a sound of relatively greater intensity has been explained by Ebhardt in terms of an increase in the emotional content or "affective tone" which the subject experiences from a more intense sound.[5] Stetson explained it in terms of muscular tension and relaxation:

> The short element in the trochee is at some distance from the accented element because it occurs *after* the pulse of the accent; all the muscle-sets have given a heavy beat and some time is required before the mobile

[4]Robert MacDougall, "The Structure of Simple Rhythm Forms," *Psychological Review, Monograph Supplement,* IV (January 1903), 364.
[5]Kurt Ebhardt, "Zwei Beiträge zur Psychologie des Rhythmus und des Tempo," *Zeitschrift für Psychologie und Physiologie der Sinnesorgane,* 18 (1898), 120-121.

> sets, though they work continuously, can produce the subordinate beat.[6]

It is not entirely clear how the motor preparation for the execution of a heavily stressed beat effects the durational value of the interval before the beat (or, in other words, the durational value of the preceding beat), although logically a greater amount of time would be required to prepare for the reproduction of a more heavily accentuated stroke than a lighter one. This assumption is apparently corroborated by Erich Schmidt's experiments with a uniform four-member metrical unit, in which a slight lengthening of the fourth beat of the 4/4 pattern (as well as a considerable lengthening of the first beat) was introduced by the subjects in reproducing an uninterrupted repetition of the beat pattern. Schmidt also found that the interval variation between the fourth and the first beats was not as constant as other interval fluctuations in the reproduction of the beat pattern and concluded, therefore, that a wide zone of temporal variation might be expected in reproducing the accented initial beat of a rhythmic group.[7]

The results of Kurt Ebhardt's study of the effect of velocity on rhythmic grouping in the reproduction of a beat pattern indicate that the rate at which a beat pattern is reproduced may be a decisive factor in determining the amount of temporal variation in the interval preceding the initial stressed beat of each group. He observed in the rapid reproduction of a uniform beat series of 1' - 2 - 3, a tendency to introduce a slight pause between groups, but, by gradually increasing the time value of the beats until a very slow tempo was reached, the tendency shifted toward connecting the last member of the group by a short time interval with the following first beat.

> Bei sehr langsamen Rhythmen verschwindet dagegen die Zusammenfassung mehr und mehr; an die Stelle der Trennung der Gruppen tritt ein allmähliches Uebergehen von der einen Gruppe zur andern, vermittelt durch das letzte Glied jeder Gruppe, auf; das letzte Glied wird dann als Auftakt angesehn und als solcher

[6] R. H. Stetson, "A Motor Theory of Rhythm and Discrete Succession," *Psychological Review*, XII (1905), 303.

[7] Erich Schmidt, *Ueber den Aufbau rhythmischer Gestalten* (Munich, 1939), pp. 37-70.

> enger mit dem ersten Glied der nächsten Gruppe verbunden.[8]
>
> (The coherence gradually fades, on the contrary, in very slow rhythms; instead of a separation between groups, a gradual connecting of one group to the next takes place by means of the last member of each group; the last member is then considered an upbeat and as such, is more closely linked with the first member of the next group.)

Ebhardt's experimental findings relating to the role of tempo in the reproduction of a uniformly spaced rhythmic series would seem to indicate that a very slow tempo is conducive to an upbeat or iambic grouping. The above discussion of psychological discrepancies in the perception and performance of time values might be summarized by the statement that the durational value of any beat in the reproduction of a rhythmic group will vary according to its position within the group; or expressed in another way, according to its relation to the time and intensity values of the beats which surround it. It may also vary according to the absolute tempo in which the group is performed and according to the physical requirements of its performance. And added to these considerations must be the factor of individual variation in the evaluation of time intervals.

Deviations from the theoretically calculated length of sounds in the performance of a melodic line on the piano were described by Garbuzov in terms of zones, the limits of which varied with the individual subject as well as with the rhythmic and melodic context in which the note appeared.[9] The size of the temporal deviation zone is thus conditioned by both subjective and objective factors. Less deviation from the mathematical standard was discovered in the reproduction of the short note values of the melody than the longer values. In performing the melodic line with a metronome, differences in length were still found to exist among the individual note values in relation to the theoretical value, although less deviation in the measure lengths was disclosed than in the free

[8]Kurt Ebhardt, *op. cit.*, 126.

[9]Nikolai Alexandrovich Garbuzov, *The Zonal Nature of Tempo and Rhythm* (Eng. trans. of Russian title) (Moscow, 1950), pp. 29-59.

performance in which the metronome did not regulate the length of the metrical units.

Among earlier studies of intensity and time values in piano performance are the experiments by Binet and Courtier[10] in 1896 and those by Mack Henderson[11] in 1933. A frequently encountered criticism of the experiments carried out by Binet and Courtier is that, with the recording equipment available to them at that time, it would not have been possible for them to obtain accurate data. One might indeed raise the question of whether the execution, as they recorded it, of an almost perfectly graduated retard on the piano, in which such a minute span of time as one-hundredth of a second was almost the precise difference in the durational interval between successive notes,[12] would not require a temporal control beyond the capacity of any pianist. Garbuzov's experiment in the detection of durational deviations from the theoretical length of time values discussed below would tend to disprove some of the data of the Binet-Courtier experiments.

On the basis of Mack Henderson's measurements of intensity and durational values in artistic piano performance with the aid of the Iowa piano camera, it is suggested that measure accents are only infrequently emphasized by means of intensity, whereas delayed entrances and the temporal extension of those beats requiring metrical stress operate as a substitute in establishing measure accentuation in performance.[13] Henderson's selection of a composition for the comparative performance which contains numerous dynamic swells (the middle section of the *G minor Nocturne, op.* 15, *no.* 3 by Chopin) is not the most convincing basis from which to draw generalizations concerning measure accents in performance, for, by his own definition, in order to be counted as a stressed beat, a note would have to be played with greater intensity than both the preceding and succeeding notes; accordingly, the occur-

[10]A. Binet and J. Courtier, "Recherches Graphiques sur la Musique," *L'Année Psychologique,* 2e Année (1896), pp. 201-222.

[11]Mack T. Henderson, "Rhythmic Organization in Artistic Piano Performance," *Iowa Studies in Psychology of Music,* 4 (February 1937).

[12]Binet and Courtier, *op. cit.,* pp. 217-218.

[13]Henderson, *op. cit.,* 292.

rence of a measure accent within a crescendo or decrescendo would obviously be more infrequent than within a uniform dynamic level. The preponderance of delayed entrances of initial measure beats recorded by Henderson might be attributed to the fact that the reiteration of two rhythmic patterns ( and ) throughout the middle section of this nocturne has the effect of grouping the rhythm in measure units. It is conceivable, therefore, that a pause would be introduced between measures in the performance of this particular example for the purpose of clarifying the rhythmic structure.

Since psychological divergences exist in estimating the durational value of rhythmically organized sounds, the question arises concerning the limits within which these variations may occur without being perceived as deviating from the theoretical length. Garbuzov found that, as a general rule, a temporal divergence in the performance of a melodic line greater than either plus or minus one-tenth of a second from the theoretically calculated length would usually be perceived by the trained listener. He summarized his findings as follows:

> These observations allow us to think that a correct and relatively certain evaluation of sound length in a melody becomes possible only when the divergence comes to tenths, and in rare cases, to hundredths of a second, and that the opinion of Binet and Courtier and their followers in regard to the possibility of perceiving deviations into the thousands of a second, is wrong.[14]

He concluded that with highly qualified musicians the zone of rhythmic divergence from the theoretical time value of sounds is very narrow and is hardly given to further improvement.

In experiments in setting the tempo of a familiar piece of music over a period of weeks, Garbuzov observed that the feeling for tempo was less developed in musicians than the rhythmic sense (although individual differences in ability were also evident); he was nevertheless convinced that the tempo zone could be substantially narrowed by practice in establish-

[14]Garbuzov, *Zonal Nature of Tempo and Rhythm,* trans. Peter Fischer, p. 71.

ing a precise tempo.[15] As might be expected, the widest tempo zone was observed in slow pieces and the least degree of tempo variation in fast pieces. A mathematically precise tempo was even achieved in rare instances, although this could only be maintained temporarily.

Despite insufficient data relating to the psychological factor in the reproduction of intensity values, it may be assumed that zones of divergence from the precise degree of intensity intended in performance also exist. Schmidt made the general observation that subjects were unable to duplicate the lightly stressed beats in a given intensity pattern, to which they first listened, with the accuracy with which they were able to reproduce the more heavily stressed beats, although an exception to this was observed in the duplication of intensity of the second beat in a 4/4 beat pattern, which proved to be extremely constant.[16]

Although more research is necessary before the complex interrelation of the various factors which enter into rhythmic performance can be fully analyzed, on the basis of the psychological data discussed here the following suggestions applicable to performance are given:

1. Attention should be given in performance to notes of long durational value, due to their greater magnitude of divergence from the theoretical value.

2. Particular attention should be directed toward the time interval immediately preceding and following the accented beat of a rhythmic group, due to the wide zone of temporal divergence occurring in the performance of heavily accentuated beats.

3. The performer is cautioned against anticipating the accented beat at the close of an upbeat group to the extent that the value of the note preceding it is noticeably curtailed. One might assume that rushing into accents is to be particularly avoided in a slow tempo, inasmuch as the brief interval between notes in a fast tempo is apparently extended by the

[15] *Ibid.*, pp. 7-28.
[16] Schmidt, *Aufbau rhythmischer Gestalten*, pp. 25-37.

increased muscular preparation for the execution of the accent, thereby offsetting the tendency to anticipate it. If the intention is to organize a rhythmic series in trochaic groups, the time interval separating the groups must not be lessened through anticipation of the accented beginning of each group as the overestimation of this critical time interval could effect a change from trochaic to iambic grouping.

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ARISTOTLE'S CONCEPT OF MIMESIS

WILLIAM E. CALLAHAN

One of the most celebrated books on literary criticism in antiquity is Aristotle's *Poetics*. The present or surviving version of that work is a somewhat uneven discussion of the "imitative art of poetry," with the chief emphasis being placed upon tragedy. It is possible, even probable, that the surviving redaction of the *Poetics* is only a part of a larger work or is a summary of certain sections of a much longer dialogue on poetry which no longer survives except as isolated fragments. If either of these suggestions is correct, then it would account for the "omission" in the *Poetics* of a promised discussion of comedy and the exclusion of any discussion of lyric poetry.

The *Poetics* has had, of course, a long (if checkered) history of interpretation (and misinterpretation). Most modern (non-classical) studies seem to major on Aristotle's definition and treatment of tragedy and its relationship to the history of Greek drama. Among the modern classical scholars considerable attention has been focused upon his concept of "imitation" (mimēsis). This interest is a natural one because Aristotle says early on in the *Poetics* that "Epic poetry and tragedy, as also Comedy, Dithyrambic poetry, and most flute-playing and lyre-playing, are all, viewed as a whole, modes of imitation."[1] Thus it would seem that an understanding of the concept of mimesis is a prerequisite for an interpretation of Aristotle's theory of poetry. Basically, this problem is the chief concern of this paper.

However, a word of delimitation is in order. The chief concern of this study is what Aristotle means by "imitation" and how he uses the concept in the *Poetics*. The paper will not consider the larger but somewhat different problem of the relationship between Aristotle's use of mimesis and Plato's usage,

[1] *Poetics*, 1. 1447a, 13-15.

except in an incidental way as a means of making clear the former. Also, let it be clearly stated that this interest in mimesis is philosophical rather than literary, although, as it will be shown, these two interests are not mutually exclusive nor inimical. Finally, because of the adequacy of the voluminous literature on the subject, and because of the obvious limitation of the brevity of the paper, this project will be considered as seminal in nature rather than comprehensive and explicatory.[2]

ARISTOTLE'S METHOD

In beginning, it will be pertinent to note the approach Aristotle employs in his philosophical writings. As is well known, he likes to have a clear definition of terms and a statement of the principles of the branch of knowledge under study. In addition, he proceeds by dividing the various facets of knowledge into specific subject areas, or sciences. Generally speaking, Aristotle has three basis divisions: the theoretical sciences, which deal with what is always or for the most part, including metaphysics, mathematics, and physics; the practical sciences, which deal with conduct and how to choose those relative goods that make a good man or good polis, including ethics and politics; and third, the productive sciences, which deal with how to make things, including poetics and the like.[3] Within the third category, a distinction is made between the fine arts and the useful arts, although both have imitative functions which serve to differentiate them from nature. But the fine arts are distinguished from the useful arts in the means of imitation.[4]

The methodology of Aristotle is in marked contrast to that of Plato, and probably accounts for some of the differences of usage and meaning each finds for mimesis. For example, as McKeon writes:

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[2]For example, Richard McKeon, "Literary Criticism and the Concept of Imitation in Antiquity," *Modern Philology*, 34 (1936), 1-35. Anthologized in R. S. Crane, *Critics and Criticism* (Chicago, 1952), pp. 147-175. This is a classic discussion of the subject and was quoted by practically every other secondary source that was consulted. I, too, have made use of this essay and my references have the pagination of the Crane book.

[3]Cf. McKeon, p. 161; J. H. Randall, Jr., *Aristotle* (N. Y., 1960), p. 272; *Ethics*, VI, 3, 1139b-1141a.

[4]McKeon, *Ibid.*, p. 161.

> Whereas for Plato the term "imitation" may undergo an infinite series of gradations of meanings, developed in a series of analogies, for Aristotle the term is restricted to a single literal meaning. In the second place, and as a consequence of the first difference, whereas for Plato an exposition of the word "imitation" involves an excursion through all the reaches of his philosophy, "imitation" for Aristotle is relevant only to one restricted portion of the domain of philosophy and never extends beyond it.[5]

McKeon goes on to say that Plato can ask, concerning a particular thing, if it is an imitation, in two different contexts, and receive different answers in the two contexts, whereas for Aristotle, if "a given thing is an imitation, it cannot *not* be an imitation."[6] Although in general one would agree with McKeon's characterization of the different approaches of Plato and Aristotle, it does not seem that he is correct in his contention that for Aristotle "imitation" has only one literal meaning.[7]

IMITATION AND NATURE

Before proceeding to an examination of imitation in the *Poetics,* which is the chief concern of the paper, an examination of a reference or two in the *Physics* and the *Politics* would be instructive. In Book II of the *Physics,* chapter 8, Aristotle is discussing how nature belongs to the class of causes that act for the sake of something. In the process of the discussion, he makes a comparison between processes by nature (*kinēseis kata physin*) and processes by art (*kinēseis kata technēs*). He concludes that they are not vastly different processes. By nature, a tree is made out of a seed; by art a house is made out of wood; but if the tree could have been made by art, it would have been made the same way as by nature, and if the house could have been made by nature, it would have been made the same way as by art. Then Aristotle concludes that "each step then in the series is for the sake of the next; and generally

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[5]*Ibid.,* p. 160.

[6]*Ibid.,* pp. 160-161.

[7]For a view different from McKeon, *vide* Gerald Else, *Aristotle's Poetics: The Argument* (Cambridge, 1957), p. 2 (among others). In support of McKeon, *vide* Elder Olson, ed., *Aristotle's Poetics and English Literature* (Chicago, 1965), pp. xii-xiii, note 3.

art partly completes what nature cannot bring to a finish *and partly imitates her.*"[8] What does the underscored phrase mean? A man cannot imitate nature's products: man cannot make a tree from a seed or acorn. In a sense, then, man cannot "mimick" nature; but man can imitate nature's productive activities (and nature for Aristotle is a way of acting). Art, then, can do the kind of think that nature does. In Art, man can act for an end, for a reason, and this end is one of the causes of the "art-form" produced thereby.[9] This usage of "imitate" will help to illuminate its meaning in the *Poetics.*

In Book VIII, Chapter 5, of the *Politics,* Aristotle discusses education in music. In the course of the discussion, he makes the point that music is the most imitative of the arts, especially as being images of states of character such as anger, fortitude, and the like.[10] This discussion makes it clear that by "imitating" Aristotle does not mean simply "copying." In fact, he explicitly says what he means in regards to music being an image of these states of character when he remarks that "music has the power of producing an effect on the character of the soul."[11] In other words, "music produces by its sound the *same effects* that nature produces by human character in action. A good poem or a good song arouses in us the same feelings and emotions as do the actions of a man."[12] One would do well to keep these passages from the *Physics* and the *Politics* in mind as the discussion now moves to the *Poetics.*

IMITATION IN THE POETICS

Aristotle's use of imitation or mimesis is almost entirely limited to his work on poetry. The reason for this has already been noted, that he likes to separate his subjects into their respective categories. In this connection, it can be said that the distinguishing feature of a poet is that he is an imitator.[13] Aristotle proceeds to distinguish the different types of arts and different types of poetry by noting the differences of

[8] *Physics,* II, 8, 199a15-18. (My underlines).
[9] Randall, *Op. Cit.,* pp. 275-276.
[10] *Politics,* VIII, 5, 1339a-1340b.
[11] *Ibid.,* para. 24, Barkers Translation.
[12] Randall, *Op. Cit.,* pp. 288-289.
[13] *Poetics,* 9,1451b28-29; 1,1447b15.

means, objects, and manner.[14] The details need not detain one here; but suffice it to say that his discussion culminates in his celebrated definition of tragedy. The remainder of the book is devoted to a discussion of tragedy and its various elements, culminating in the question as to which is the higher form of poetry, the epic or the tragic.

With this general summary in mind it will now be possible to look at several specific passages related to mimesis. First, Aristotle maintains that poetry had its origin in two characteristics of human nature: (1) Man is the most imitative creature in the world and delights in imitating and learns thereby; (2) man also delights in observing objects of imitation.[15] Here "imitation" seems to mean "behaving like" or "making a likeness" such as a child following in the footsteps of his father and trying to emulate his steps. However, in contradistinction to Plato, there does not seem to be the connotation of "falseness" or "inferior copy" involved in Aristotle's discussion. In fact, to dispel any such notions, it need only be noted that Aristotle connects *learning* with imitating. Also, learning is natural and pleasurable. In fact, as he says elsewhere, it is through likeness that man's memory becomes experience.[16]

A second passage that should be examined is his statement that tragedy is an imitation of action and life rather than a man or a quality. "All human happiness or misery takes the form of action; the end for which we live is a certain kind of activity, not a quality."[17] This passage is illuminated by what was observed in the *Physics* about the relation between the processes of nature and of art. Art is analogous to nature in terms of imitating a process or activity; so here, the same point obtains. Tragic poetry, as an art-form, imitates an activity rather than something static. "Imitate" must here mean "represent" or "re-present" or "re-create" rather than a strict copying, just as we have seen above. Because imitation of an action is the heart of tragedy, the plot or fable is the

[14] *Ibid.*, 1. 1447a 13-18.
[15] *Ibid.*, 4. 1448b 3-9.
[16] *Metaphysics*, I, 1, 980b 27ff. Cf. Olson, Op. Cit., p. xiii.
[17] *Poetics*, 6. 1450a 14-19; 1450b 1-4.

most important of the six elements of the tragic drama. In constructing his plot, the artist should put the actual scenes as far away as possible, Aristotle says; such a remark further strengthens the interpretation of "imitate" we have just noted.[18]

The study should now turn to a very crucial passage on imitating. It might be well here to quote Aristotle at some length:

> From what we have said it will be seen that the poet's function is to describe, not the thing that has happened, but a kind of thing that might happen, i.e. what is possible as being probable or necessary. The distinction between historian and poet is not in the one writing prose and the other verse . . . it consists really in this, that the one describes the thing that has been, and the other a kind of thing that might be. Hence poetry is something more philosophic and of graver import than history, since its statements are of the nature rather of universals, whereas those of history are singulars. By a universal statement I mean one as to what such or such a kind of man will probably or necessarily say or do. . . .[19]

Without going into great detail, several things are important in this passage and may be noted summarily. First, a distinction can be made between imitating a particular and imitating a universal. This distinction makes it clear that "imitating" is not a strict "copying" in poetry as it might be in art (painting). Second, in assigning philosophic importance to poetry, Aristotle removes any doubt about "imitating" meaning "fictionalize" in the sense of making something unreal (in the Platonic sense of that word). Hence the imitator does not copy in an inferior way an eternal form or idea, nor does he copy an idea in his mind. Third, the universal statements of the poet derive their universality not from nature or from the psychological makeup of the poet but from the character of the kind of agent engaged in the activity which the plot imitates. Fourth, the further analogy between the processes of art and the processes of nature is obvious; there is a necessity in nature in that its activities happen always or for the

[18] *Ibid.*, 17. 1455a 22ff.
[19] *Ibid.*, 9. 1451a 36-1451b 9.

most part the same, and, due to the character of the "types" of people "imitated" by the poet in his plot, so does the tragedy. At this point, McKeon's remark is pertinent: "Imitation may be said to be, in the fine arts, the presentation of an aspect of things in a matter other than its natural matter, rendered inevitable by reasons other than its natural reasons."[20]

There are, perhaps, other passages in the *Poetics* that could be or even should be noted; however, the limited purpose stated earlier has been achieved. Certain conclusions and philosophic implications of Aristotle's concept of mimesis must now be indicated.

CONCLUSIONS AND IMPLICATIONS

One conclusion from the study is obvious and has been noted on several occasions in the body of the paper, that is the close affinity between the processes of nature and the processes of art. Nature works for an end; art works for an end. One of the four causes of nature is the end, and one must know this cause (and the other three) in order to know anything in the theoretical sciences. The end or purpose of the poet is likewise a cause of his art-form, especially the tragedy. Although this particular passage was not examined above, the end or purpose of the tragedy is the catharsis of pity and fear that the plot evokes. Nature also is *productive* of certain things, e.g., a tree; the poet imitates this productive process by producing the kind of thing nature would produce if nature were capable of producing the kind of things the artist produces.

A second conclusion one would draw is that for Aristotle the word "imitation" does not have the odious connotation that it often has for Plato. The evidence for that conclusion has been amply noted. (However, as was said in the introduction, the purpose here is not to deal with Plato; that problem is more involved than this project.) What should be emphasized is that Aristotle does not let ontological or metaphysical presuppositions dictate how he uses a word like mimesis in a non-

[20]McKeon, *Op. Cit.*, p. 162. However, he is not to be charged with the interpretation of the preceding paragraph.

theoretical science like poetics. He restricts himself to his stated subject matter.

Third, it does not appear that McKeon is correct when he remarks that for Aristotle there is only one, literal meaning for mimesis. Indeed, even in the *Poetics* the word has several possible *connotations*. If, however, McKeon means only that he does not have mutually exclusive or contradictory meanings, then no objection would arise. The word "imitate" for Aristotle has several possible meanings: represent, re-present, make-believe, re-create, *et al.* However, it seems to mean "copying" only when it refers to imitating particulars, as in a literal painting of an object.

Fourth, one is intrigued by the association of poetry with philosophic import, an association noted in Aristotle's distinction between poetry and history. Often in the modern world, the poet and the philosopher have been in enemy camps. Especially has this been so in this day of philosophic emphasis on linguistic analysis, to the extent that some have wished to relegate philosophy to the logical analysis of language as a tool of science; and, since poetry has been regarded as the expressive or emotive use of the language, it has been put in an entirely different category from "philosophy." And, even though Aristotle primarily has reference to tragedy, it seems that his association of the "poetic impulse" with the philosophical is a true recognition of the almost inherent cohesiveness of the various branches of the Humanities with each other. Perhaps a widespread re-awareness of this unity might restore the modern MULTIversity to its UNIversity status.

In conclusion, such a study as this paper has required has served to reinforce this writer's respect and admiration for classical philosophy in general and Aristotle in particular. In the true Aristotelian sense of the word, modern philosophers could do no better thing than "imitate" the philosophic activities of the Greeks.

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All of the above were consulted, but not all were used directly.

COUNTEREXAMPLES TO THE ANTITHESIS OF COMMUTATIVITY AND ANTICOMMUTATIVITY

DIANE SPRESSER

It is well-known that the mathematical terms *symmetric* and *antisymmetric* are not antitheses of one another. One can readily find relations which have both properties and also relations which have neither property. The terms *open* and *closed* are further examples of seemingly opposite terms which are not truly antithetical.

In their paper "Linearization in Rings and Algebras," Goldman and Kass note that every ring R in which each element satisfies the equation $x^2 = 0$ is anticommutative ($xy = -yx$ for all x and y in R).[1] Some natural questions occur here. Are the terms *commutative* and *anticommutative* antithetical, or can one find an example of a ring in which both of these properties hold? Furthermore, do rings exist in which neither property holds?

Every Boolean ring $\langle R, +, \cdot \rangle$ is both commutative and anticommutative. Many standard algebra texts contain exercises which suggest a proof of the commutativity of Boolean rings.[2] In fact, one can prove that every Boolean ring is a commutative ring of characteristic two. Now, since every element x in R is its own additive inverse,

$$xy = yx = y\ (-x) = -(yx)$$

and $\langle R, +, \cdot \rangle$ is also anticommutative. Therefore, every Boolean ring is both commutative and anticommutative.

The ring of all 2 x 2 matrices with real entries is neither commutative nor anticommutative. If one selects $x = y = I_2$, he finds that anticommutativity does not hold. It is well-known that commutativity also does not hold. Hence, one can

[1] Jerry Goldman and Seymour Kass, "Linearization in Rings and Algebras," *The American Mathematical Monthly,* April, 1969, p. 348.

[2] I. N. Herstein, *Topics in Algebra,* p. 91.

find natural and uncontrived rings in which both properties hold and in which neither property holds.

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ABSTRACTS OF MASTERS' THESES

RELATIONSHIP OF ELASTIN CONTENT OF THE SPLEEN TO DIFFERENT AGE AND WEIGHT GROUPS OF RATS AND TO SPLEEN WEIGHT IN MICE

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Since the beginning of the nineteenth century, a variety of procedures have been proposed for the isolation of elastic fibers. Most of these techniques were based on the resistance of the elastic fibers to boiling water, dilute acids, and dilute alkalis; and most were used in the determination of the ultrastructure of the fiber rather than collecting quantitative data on elastin content of specific organs. This study attempted to add to the quantitative data.

The elastin content of the spleen was determined for groupings of rats and mice by a method outlined by Lowry, Gilligan, and Katersky (1941). The percentage elastin content of the spleen was then correlated to age, spleen weight, and body weight in rats and to spleen weight in mice. Photomicrographs were made of orcein stained sections of rat and mouse spleens to illustrate the arrangement of elastic fibers.

Results of the rat and mice groups show that as the body weight increases, the spleen weight increases; and as the spleen and body weights increase, the elastin content, in grams, also increases. However, the percentage elastin content of the spleen is not significantly correlated to the spleen weight and the body weight. Also the percentage elastin content of the spleen is not significantly related to the increase in age of the rats.

The photomicrographs support the previously described arrangement of elastic fibers in the spleen. However, further experimentations with varying techniques are needed to test the validity of the results and conclusions.

A STUDY OF IRONY IN BERNARD MALAMUD'S NOVELS

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The purpose of this study is to examine the use of irony in Bernard Malamud's five novels. The study concentrates on an analysis of irony as it is used in each of the novels, and from this analysis come the conclusions that the ironic vision is central to Malamud's themes and style, that the irony in his novels is achieved through the juxtaposition of realism and symbolism, and that this irony is primarily Jewish in nature, being formed by the conflict of actual with ideal, of "is" with "ought."

The first chapter of the study describes the problem under consideration, the procedure of research, and the plan of the study. The second chapter defines the terms "realism," "symbolism," and "irony" as they are used in the study; more specifically, it indicates the importance of these literary modes in the understanding and evaluation of modern literature as a whole and of the modern novel in particular. Chapter three is an inquiry into the nature of Jewish irony and an examination of this type of irony in the novels of three representative contemporary Jewish-American novelists, Saul Bellow, Norman Mailer, and Philip Roth.

Chapter four gives a critical overview of Bernard Malamud's use of irony as it is interpreted by a variety of critics and as it is interpreted by the writer of this paper. This chapter attempts to show that Malamud fuses the modes of realism and symbolism into a new style (not an impurity, but a new manner) which is electric with ironic contrasts between real and ideal, and which seems to gain a firmer hold on reality through combining modes than could be gained using either mode pre-

dominantly. What Malamud achieves in his fiction is an ironic tension showing man torn between his dreams of ideality and his continuing perception of flawed reality, between his concept of perfection and his awareness of imperfect humanity; but such a view of life is not pessimistic, as many critics would argue, but inherently optimistic, valuing the tenacity of the human spirit that gains a degree of nobility in reaching for perfection even though the defeat of such effort is certain.

Chapter five is the analysis of the five novels Bernard Malamud has written to date, *The Natural* (1952), *The Assistant* (1957), *A New Life* (1961), *The Fixer* (1966), and *Pictures of* Fidelman; *An Exhibition* (1969). Each of the novels, taken in order of publication, is studied in the light of existing critical comment and in connection with what the writer of this paper has found in examining and comparing them. Most of the observations and conclusions in this chapter are the original work of the writer of this paper, and the writer hopes to give a fresh interpretation of Malamud's novels, or to provide, at least, a clearer approach toward understanding Malamud's novels. Malamud is presented neither as a realist, nor as a symbolist, but as an ironist in the tradition of Jewish irony who employs both realism and symbolism in ironic conjunction.

Chapter six gives a brief summarizing statement as a conclusion to the thesis.

THE EFFECTS OF SUBLETHAL DOSAGES OF FUMIGANT INSECTICIDES ON THE LARVAE PRODUCTION IN *SARCOPHAGA BULLATA*

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Female *Sarcophaga bullata* were exposed to sublethal dosages of the fumigant insecticides carbon disulfide and ethylene dichloride mixed with carbon tetrachloride, and dimethyl dichlorovinyl phosphate to determine their effects on larvae production. During the treatment, oxygen uptake was measured as a criterion of metabolic activity. The results showed that all treatments were stimulating to larvae production in amounts that were correlated with the insecticide dosages when compared to the controls. An increase in oxygen uptake of treated groups over the controls was observed and suggested a stress on metabolic activity.

A CONTRAST OF VALUES IN THE WORKS OF EDITH WHARTON

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This thesis examines significant works of Edith Wharton to contrast the values of the old and the new rich as she sees them. Mrs. Wharton, a New Yorker, had the tastes, habits, and education expected of upper class women but developed a critical attitude toward the wealthy, idle people of her set as they placed an increasing importance upon appearance. Good

manners became equated with honor, and conforming to the accepted behaviour pattern, with virtue. The rich seldom objected to evil, only to indiscretion. Material things, British tutors, and English classics set their life style.

Although Mrs. Wharton criticized the growth of money values, she stressed purchased beauty as an essential value of life. She watched the moneyed barbarians crash New York society with their overwhelming cash resources and their lack of culture or respect for tradition. Where the old rich valued business incorruptibility and kept leisurely business hours, the new rich grabbed every chance to get ahead financially by speculation or manipulation. Whereas the old rich dreaded innovation and shrank from responsibility, the new rich welcomed innovation and considered those who shrank from responsibility to be shirkers. As the two societies merged, most vestiges of honesty disappeared. As Mrs. Wharton observed the emerging prominence of Middle Western values, she changed the heroes of her stories from old family types to Middle Western types, but because of her unfamiliarity with this kind of American, these portrayals are less authentic than her earlier ones.

The old families valued a united family front and respectability. Their daughters were assumed to be virtuous and their sons discreet. If a member of society had plenty of money or influence, he could do almost anything socially so long as he kept up appearances. Those, like Lily Bart of *The House of Mirth,* who lacked money or influence, faced a much stricter code and could be destroyed. The old families placed a social stigma on divorce, but by the time the invaders had entrenched themselves in society, divorce had become so commonplace it was merely an object for satire.

The futile and pointless activity of the rich, both old and new, generated a self-righteous philanthropy which seemed to be nothing more than expensive plans to force the whole world to "say its prayers and brush its teeth" in the name of uplift. Since the upper classes, as Edith Wharton pictures them, live merely for money and pleasure, they seem to be incapable of magnanimous action, real love, or even spontaneity.

Taste is sadly lacking in both old and new rich. The old rich fail to recognize true talent as illustrated in such stories as "False Dawn" and "The Spark." The new rich consider ostentation and expense to be the measure of all values in *The Custom of the Country* and *The Gods Arrive.*

Although Mrs. Wharton disapproves of selfishness and waste, many of her characters suffer "sterile pain" when they do endulge in self-sacrifice. Although some characters complain of municipal corruption, they safely decide that the ones to start a reform are those who have no private interests at stake.

Religious practice is perfunctory and ritualistic. Since God is one of the names on the visiting list, the rich go to church expecting to be both bored by the preacher and seen by their associates.

Mrs. Wharton can best be remembered for her satirical portrayals of the old rich with their charmless, dull though expensive habits and values and the new rich with their loud, ambitious but also expensive habits and values as their families and their fiscal values merge.

GLASSBORO: STORY OF A SUMMIT

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The main objectives of this thesis are: First, to provide a history of the Glassboro Summit Conference which took place on June 23 and 25, 1967; Second, to compare the conference at Glassboro and its results with the results of the other four post World War II United States-Soviet Union summit meetings so as to arrive at an assessment of the value of the summit method of diplomacy; Third, to provide a test of the thesis presented by Robert D. Bole in the only published history of the Glassboro meeting, *Summit At Hollybush*. The opinions of other writers will also be examined and compared to those presented by Bole as well as those held by the author. Lastly, the author hopes to present some conclusions regarding the impact of the summit meeting at Glassboro on international affairs, the town and people of Glassboro, N. J., and Glassboro State College which hosted the conference.

In order to evaluate the Glassboro summit meeting, one must establish a frame of reference. This is the primary function of the first two chapters in which the author, in contrast to Bole, attempted to give the reader an in-depth understanding of Glassboro's background by tracing the genealogy of the meeting, so to speak. Glassboro's "family tree" he discovered, consisted of four members. These were, the first postwar summit meeting at Geneva in 1955, the Camp David meeting between President Eisenhower and Khrushchev in 1959, the Paris Summit of 1960, and the Vienna meeting between Khrushchev and President Kennedy. Of these, none was able to bring about any results which led to an immediate and permanent alteration of the Cold War between the United States and the U.S.S.R. In fact, the last two, prior to Glassboro, seemed to lead to an escalation of cold war tension.

The second chapter attempts to provide a still deeper insight into the immediate background of the Glassboro meeting. Once again, the author goes beyond the outline of the Middle East Crisis and the resulting Six-Day War presented by Bole. In this case, he found the first part of Bole's thesis to be valid: the road to Glassboro did begin in the Middle East. He also accepted Bole's position that the major credit for breaking the diplomatic deadlock over the site belonged to New Jersey's Governor Richard J. Hughes.

The third chapter, entitled "Transformation", was based largely on material derived from Bole. This was because many of the details contained in it were found only in his book and did not make their way into the press accounts. Bole, who is a professor of mathematics at Glassboro, used oral interviews to obtain much of the information for his work. Unfortunately, he did not footnote the book, so it was impossible to check his sources, and although he stated in his bibliography that the interview transcript would be available to scholars, the author found that this was not yet the case when he spoke by telephone with Dr. Bole. The author, however, was unable to locate any information which would indicate that Bole's account was substantially in error where he described the changes that were made in Hollybush.

Bole's major weakness was his discussion of the impact of the Glassboro meeting on world affairs. He never really made a complete statement as to what value one might attach to the conference. The author found that Glassboro, like two of its predecessors, Geneva and Camp David, helped reduce world tension temporarily, while failing to make any immediate and permanent alteration in the course of the Cold War. Unlike them, however, Glassboro seems to have left something which still may produce a positive effect. This something, according to former Secretary of State Dean Rusk, is the current strategic Arms Limitation Talks.

THE EFFECTS OF pH ON THE REGENERATION OF *DUGESIA DOROTOCEPHALA*

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There have been numerous studies undertaken concerning the regeneration of planarians and the effects of various substances on that regeneration. Since many of the substances tested were either acidic or basic, it is believed that a study relating the effects of pH on the regeneration of planarians is needed.

The purpose of this study is to determine the effects of acidity and alkalinity on the rate of the head regeneration of the planarian, *Dugesia dorotocephala,* at two different temperatures, an optimum temperature of twenty degrees centigrade and an higher than optimum temperature of twenty-seven degrees centigrade.

The decapitated sections of *Dugesia dorotocephala* were tested at the pH levels of 5.0, 6.0, 8.0 and 9.0 and were buffered with tris-hydroxymethyl amino methane buffer. The "t" test was used to determine the mean differences in data obtained under the statistical significance of various treatments.

It was found that at twenty degrees centigrade, the regeneration rate of the planarians in the acidic solutions was greatly depressed, especially during the early stages of regeneration. The rate of regeneration of the planarians in the alkaline solutions was also depressed at all stages.

It was also found that at twenty-seven degrees centigrade a pattern similar to that of the trial at twenty degrees centigrade emerged, the results being more erratic and the times of regeneration being much shorter.

The cause of the retardation of the early stages of regeneration of the planarians in the acidic solutions was thought to be a combination of factors, an oxygen depression caused by the acidic environment, the inability of the planarians to change the pH of their buffered medium to an optimum pH value, and an injury potential resulting from the severence of the head. A large amount of ionic material present in the acidic solutions could account for the persistence of this potential.

The regeneration rates of the planarians in the alkaline solutions were retarded to a lesser degree. The causes of this were thought to be the inability of the planarians to change the pH of their buffered medium and a reduced injury potential resulting from a smaller amount of ionic material present in their environment.

The effects of pH on the regeneration rate of the planarians appeared to be basically similar at both twenty degrees and twenty-seven degrees centigrade, the faster rates at the higher temperature being a function of the higher metabolic rate of the organism as a whole.

AN INVESTIGATION OF THE COMPARATIVE EFFECTS OF SYSTEMATIC TRAINING PROGRAMS ON VERTICAL JUMP SCORES

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The use of weights and weight training has been one of the focal points of attention during the past two decades. It has been established by some physical educators and athletic coaches that weight training will improve athletic performance and skill learning. Basketball coaches are constantly looking for better ways to improve jumping skills. This skill is very important in rebounding.

The primary purpose of this study was to compare the effects of three systematic training programs designed to im-

prove jumping skill on vertical jump scores. The Sargent Vertical Jump Test was used to obtain the vertical jump scores. Two scores were used: the best of three jumps with the right hand and the best of three jumps with the left hand.

Data were obtained from five groups of male subjects from the Harrisonburg High School boys' basketball and track teams. Each group participated in a different program: (1) Traditional weight training program (Program W), (2) Specific overload training program (Program O), (3) Combination of traditional weight training and specific overload program (Program C), (4) Running (Track) program (Program T), and (5) Control program (Program X).

Each program was carried out for a period of ten weeks with three training periods a week. During this time each group was tested six times.

The data were analyzed by the use of variance and "t" test techniques. The statistical analysis indicated there were significant differences between pre-test and post-test scores. It also showed significant differences between different programs.

The following conclusions were established:

1. All subjects improved their vertical jump scores during the ten-week program.
2. The final mean improvement ranged from .58 inch to 2.84 inches.
3. There was a statistically significant improvement of vertical jump scores in the traditional weight training, specific overload training, and the combination of traditional weight training and specific overload training.
4. There was no statistical significance in the difference between the final means of the traditional weight training, the specific overload training, and the combination training programs.
5. There was no statistical significance in the difference between the final means of the running (Track) program and the control program.

THE NAPOLEON OF GOTHAM A STUDY OF THE LIFE OF CHARLES BROADWAY ROUSS

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Charles Broadway Rouss was a Winchester, Virginia, native and Confedreate veteran who built from nothing a multi-million dollar fortune as a dry goods merchant in New York City in the late nineteenth century. He was known to millions in his own day for his eccentricities, business ability, widespread philanthropy, and phenomenal success.

Today, outside of Winchester, the city with whom he shared so much of his wealth, Rouss is practically unknown. The major purposes of this study are to relate the life of this extraordinary man and to place him in his proper perspective both as a business pioneer and a historical figure.

This writer first heard the name Charles Broadway Rouss six years ago when Dr. Millard K. Bushong lectured to an American history class on the merchant's career. Dr. Bushong, a prominent Shenandoah Valley historian, planted an incentive when he said that he "just knew that some carpetbagger would come down from up North and steal him as a thesis topic." Upon the author's subsequential removal to the Winchester area, the spark of interest in Mr. Rouss continued to grow until finally this end product is at hand.

Written thus from the point of view of one who now hails from the community which was so influenced by Rouss' life, this work is based largely on primary materials. By far the most important sources to the study were the newspapers printed in the Winchester area from 1876 to 1902. Although unindexed, these papers present a scrapbook account of all that

was said by or about Rouss of public importance during his lifetime. They were of special significance because of their coverage of so many articles from the national press on his career and for the reprinting of the Rouss' autobiographical editorials from the *Monthly Auction Trade Journal,* which he published after 1876. Since he left no personal papers and has had no scholarly biographer, this writer relied on these journals for bits and pieces of information which he stitched together to make a whole. Next to the newspapers, the most useful source was a series of letters from Rouss to his close friend, former Virginia Governor F. W. M. Holliday of Winchester, which give an intimate and behind-the-scenes view of the merchant's career.

This thesis begins with a look at Rouss' early life in Winchester and the surrounding area where his character and aspirations were shaped. Here he opened his first business and learned many of the principles which would bring him success in later life. When the war came in 1861, he transferred his business to Richmond where he engaged in blockade-running until his enlistment as a private in the Confederate Army. When the war ended, his ante-bellum fortune of $60,-000 had been swept out of existence.

The year 1866 found Rouss in New York City determined to win fame and fortune. Instead he met with nothing but reverses for months, surviving by eating at the city's free lunches and sleeping in parks. Finally a start was made and by the year 1875, Rouss was worth a quarter of a million dollars. Then came a second failure with all being lost in the panic of that year, and Rouss found himself back at the free lunches.

In 1876 Rouss was in business again and by 1888 had hit the million mark, having established a national reputation for his success. For the next decade he was a representative figure in the business world, whose opinions were sought and might well have influenced national policy. His fame became even more widespread in these years as a result of his benefactions, which totaled perhaps as much as a million dollars, and because of the press' coverage of his unusual beliefs and habits.

The Rouss career ended where it had begun. In the city of Winchester, to whom he had been a conquering hero and a generous friend, his remains were inurned in 1902.

It is the conclusion of this study that Charles Broadway Rouss was a pioneer in the business world coming into being in late nineteenth century America and that many of his practices helped to shape it. This study further reveals that Rouss has been unjustly overlooked by history and that he should rightfully occupy a niche in the midst of that rough-hewn economic nobility who fought their way to the top in this era and to whom historians have applied the epithet, Robber Barons.

A PRELIMINARY INVESTIGATION OF THE OXIDATION OF KREBS CYCLE INTERMEDIATES BY *KARLINGIA ROSEA*

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Respirometric studies using a Gilson differential respirometer, showed that homogenates of *Karlingia rosea,* grown on a trypticase, glucose, and yeast extract medium, oxidized isocitrate and succinate. Alpha-ketoglutarate, citrate, fumarate, malate, oxalacetate, and glucose were not respired. Succinate respiration was enhanced by prior exposure to citrate, fumarate, malate, and succinate. Sparked respiration of succinate was inhibited by the introduction of chloramphenicol.

SEASONAL PERIODICITY OF PHYTOPLANKTON IN SILVER LAKE, ROCKINGHAM COUNTY, VIRGINIA

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This investigation is concerned with the limnology of a small reservoir impoundment in the western part of Virginia. It is a preliminary study which attempts to establish the taxonomic identity of the phytoplankton and detect any seasonal, as well as diel, fluctuations correlated with the prevailing physical and chemical conditions of the lake. Desmids and diatoms were present in all collections. *Dinobryon divergens* was dominant during the summer months, while *Spirogyra* dominated the colder months. The lake was oligotrophic in productivity which is characteristic of older established hard-water lakes. The numbers and species of phytoplankters present varied with the seasonal conditions. Fifty-four genera were collected from the lake during the study period which extended over twelve months.

THE UTILIZATION OF CARBON BY *PHLYCTOCHYTRIUM SEMIGLOBOSUM*

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The utilization of carbon by *Phlyctochytrium semiglobosum* has been observed in this study using a medium containing glucose labeled with C^{14} as the sole carbon source.

The fate of this C^{14} was determined by counting the activity in the carbon dioxide, lipid and cell residue fractions.

This study indicates that of the C^{14} utilized 23.1% was found in evolved CO_2, 7.8% in the lipid fractions and 69.2% in the remaining cell residue.

The significance of these data is discussed in section IV of the text.

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