

INTRODUCTION TO A NEW JOURNAL

J. W. CUNNINGHAM
North Carolina State University

INTRODUCTION

On behalf of the editors, I am pleased to introduce *Ergometrika*, to my knowledge the only peer-reviewed journal dedicated exclusively to the analysis and study of human work. The journal is sponsored by the Institute for Job and Occupational Analysis. Although I have expounded for some years on the need for a publication outlet and information source in this area, I must credit Drs. Mitchell and Atkins for taking the initiative in launching this enterprise, which I joined only after the journal had been named and the web page had been posted. Dr. Mitchell and I had discussed the possibility of such a journal as early as 1984, at the American Psychological Association meeting in Toronto, but as often happens with ideas floated in barroom conversation, this one went by the board. *Ergometrika's* beginning stems more directly from informal discussions among some of the participants at a recent job analysis symposium (Mitchell, Bennett, & Strickland, 1999).

The journal's title derives from the term "ergometrics" ("erg-" deriving from the Greek word *ergon*, or "work"), which I proposed earlier in my career as a label for the quantitative study of human work (Cunningham, 1971, 1988; McCormick, 1979). The Appendix contains an excerpt from my original writing on this topic, in which I defined "ergometrics" and distinguished it from the term "ergonomics" (Cunningham, 1971). I am including this excerpt for background purposes only and with the following caveats:

- My original definition of ergometrics was formulated within an educational context, with an emphasis on psychometrics. It should not be interpreted as defining limits or parameters for the journal.
- My characterization of the field of ergonomics was probably overly narrow, even at the time it was written, and is definitely outdated today.

Today's ergonomics is a much broader field than depicted in the excerpt (cf. Meister, 1999) and has an important contribution to make to the advancement of ergometrics.

The term "ergometrics" appears to be an inherently likely combination, as evidenced by the fact that others have produced it independently. I have identified two companies that use the term in their titles and have been told there are others. One of these companies has adopted an interpretation similar to mine (Ergometrics and Applied Research, Inc., www.ergometrics.org; O.L. Spurlin & T.L. Doolittle, personal communications, February 25, 2000), whereas the other proposes the combination of "ERGO = Therefore" plus "METRICS = Measure" (ERGOMETRICS Ireland Ltd., www.ergometrics.com). To my knowledge, however, other uses do not predate that in the Appendix, and I could find no previous attempts to define the term in detail or apply it to a field of study—with some possible exception in the preestablished use of the word "ergometer" (Gove, 1968). Although I did not lobby for it, the title *Ergometrika* seems compatible with our intended purpose and with an apparent trend toward a more generic, nomothetic approach to work analysis and description (Cunningham, 1996).

Historically, work has always been central to human existence (Dawis & Lofquist, 1983; McCormick, 1979)—or at least, according to Genesis, that has been our lot since the Fall in the Garden of Eden. Archeologists have been able to reconstruct the lifestyles of prehistoric humans based largely on analysis of the tools they used to make a living. In today's society, our self-identity is tied closely to the work we do (Gini, 2000; Sennett, 1998). Although structured thinking about the nature of work can be traced back as early as ancient China and Greece, systematic methodological approaches to the study of work did not begin in earnest until the early 1900's



(Mitchell, 1988; Primoff & Fine, 1988). The increasing interest in work analysis since that time can be seen in the trend from short sections and chapters written on the topic earlier in the century to entire volumes devoted to it more recently (E.A. Fleishman, personal communication, August 26, 2000). Today, as noted by Gael (1988), "Hardly a program of interest to human resource specialists and other practitioners whose work pertains to organizational personnel does not depend on or cannot benefit from job analysis results" (p. xv). Primoff and Fine (1988), Mitchell (1988), and Mitchell and Driskill (1996) offer excellent accounts of the history of work analysis. Following is a selected listing of some major contributors to the field during the 1900's, taken primarily from these historical reports, with a few additions of my own. This journal is dedicated to these and other 20th Century contributors to the systematic study of work. The list is by no means comprehensive, and I apologize to the reader for any glaring omissions.¹

Frederick W. Taylor, while working at the Midvale Steel and Bethlehem Steel companies, developed a method for analyzing tasks in terms of more basic elemental motions, each of which he timed by stopwatch. Tasks were redesigned based on their elemental motions, and standard task performance times were estimated by combining the individual times of the rearranged elements (Barnes, 1940). Well before the formal introduction of modern goal-setting theory and expectancy theory, Taylor emphasized the importance of (a) setting specific work goals for employees and providing them with regular feedback of results, (b) training them to work effectively, and (c) promoting their expectation that effort will be rewarded (Wren & Greenwood, 1998). Known as the father of scientific management and a pioneer in time study, Taylor described his approach in the books, *The Principles of Scientific Management* (1911a) and *Common Sense Applied to Motion and Time Study* (1911b).

Frank B. and Lillian E. Gilbreth, two other prominent figures in the scientific management movement, combined his engineering background with her training in psychology in developing some of the early methods of motion study (McCormick, 1979). Frank began his career in the construction industry, later leaving the trade to become a full-time consultant in collaboration with Lillian. Lillian completed her doctorate at Brown University, continued consulting after Frank's death, and held faculty appointments at Purdue University, the Newark College of Engineering, and the University of Wisconsin (L.M. Gilbreth, 1998; Wren & Greenwood, 1998). Part of the Gilbreths' approach

involved formulation of a set of generic activities or elements, called "therbligs," applicable to the analysis of any physical task. Task efficiency was improved through elimination of unnecessary elements and rearrangement of the remaining ones. This may have been the first worker-oriented approach to job analysis (F.B. Gilbreth, 1911; Gilbreth & Gilbreth, 1916, 1917).

Hugo Munsterberg, one of the founders of applied psychology in the United States, immigrated from Germany, where he had earned his doctorate in experimental psychology under Wilhelm Wundt, to join the faculty at Harvard University. The most publicly acclaimed psychologist of his time, Munsterberg wrote many popular magazine articles and books on the application of psychology to a wide range of problems (Schultz & Schultz, 1996). Inspired by Frederick Taylor's work, Munsterberg embarked on consulting activities in industry related to such problems as employee selection and workplace design (Schultz & Schultz, 1996; Wren & Greenwood, 1998). Among his many contributions was his pioneering application of systematic methods in estimating job requirements for personnel selection purposes. His book, *Psychology and Industrial Efficiency* (1913), served as a model for the emerging field of industrial psychology, and he is considered by many to be the father of the field (along with Walter Dill Scott; Berry, 1998; Blum & Naylor, 1968).

Walter Van Dyke Bingham founded the Department of Applied Psychology at the Carnegie Institute of Technology in 1915. Bingham, as well as Munsterberg, was an early proponent of job analysis as an essential step in the development of personnel selection and performance appraisal systems (Bingham, 1939; Bingham & Moore, 1941; Ghiselli & Brown, 1955). While at the Carnegie Institute and while serving with the War Department during World Wars I and II, he influenced the development of several large-scale job-analysis efforts, conducted by such organizations as the Division of Cooperative Research at the Carnegie Institute, the American Council of Education, the Occupational Research Program of the U.S. Employment Service, and the Committee on Classification of Personnel for the U.S. Army (Ferguson, 1952; Thurstone, 1952).

Walter Dill Scott, though best known for his work in the field of advertising, also made significant contributions to the advancement of systematic work analysis, serving during WWI with Walter Bingham as co-director of the Committee on the Classification of Personnel in the Army. Before the war, Scott had been involved in establishing trait requirements for



sales occupations. Carrying some of that work over to the Army's classification committee, he oversaw the development of job specifications for officer and enlisted specialties. After WWI, Scott and his associates founded the first psychological consulting firm, the Scott Company of Philadelphia, through which they applied the Army job analysis procedures to problems in the private sector. Their procedures were described in a book titled *Personnel Management* (Scott, Clothier, & Spriegel, 1954).

Morris S. Viteles, working through the National Research Council, developed a questionnaire containing the descriptions of 32 trait requirements on which jobs were rated. The resultant ratings for each job were displayed in a graphic profile called a "job psychograph" (Viteles, 1923). Perhaps the first of the structured job-analysis questionnaires, Viteles' psychograph was the prototype for the U.S. Employment Service's (USES; 1944) Worker Characteristics Form and the forerunner to later generations of attribute-requirement inventories, including the USES's subsequently expanded worker trait requirements (Droege, 1988; Trattner, Fine, & Kubis, 1955; U.S. Department of Labor, 1956, 1991) as well as some of the instruments in the Department of Labor's most recently developed Occupational Information Network (O*NET; Peterson, Mumford, Borman, Jeanneret, & Fleishman, 1999). Viteles authored one of the early books on industrial psychology (Viteles, 1932).

Carroll L. Shartle, in 1935, became Chief of the Worker Analysis Section of the U.S. Department of Labor's newly formed Occupational Research Program, which later became the Occupational Analysis Section of the USES. While in that position, he oversaw the development of the Worker Characteristics Form and publication of the first edition of the *Dictionary of Occupational Titles*. Following World War II, Shartle joined the faculty at The Ohio State University where he developed the Work Analysis Forms in collaboration with Ralph M. Stogdill (Shartle & Stogdill, 1957) and authored *Occupational Information* (Shartle, 1952), which saw three editions from 1944 to 1959 and was the first book devoted exclusively to job and occupational analysis. This book established occupational analysis as a field of study and introduced a number of useful methods, concepts and definitions, such as the now generally accepted distinctions between the terms "position," "job," and "occupation."

John C. Flanagan began his career in 1935 at the Cooperative Test Service, later joining the U.S. Army Air Corps at the beginning of World War II (Koppes, 1999). While serving as director of the Army Aviation

Psychology Program, he developed the critical incident technique (CIT), which involved the recording of job-incumbent behaviors that were particularly effective or ineffective in producing successful outcomes (Flanagan, 1949, 1954). Although designed primarily to support the pilot selection program, the CIT was also used in training program development, the diagnosis of flight failures, and the development of criteria for combat leadership (Bownas & Bernardin, 1988). After the war, Flanagan joined the faculty at the University of Pittsburgh and became founding president of the American Institutes for Research where he continued to develop and apply the CIT, which has found widespread use in both the private and public sectors. In addition to the aforementioned applications, the CIT has been used in job design and in the development of performance appraisal systems (Bownas & Bernardin, 1988). Flanagan made other significant methodological contributions in the areas of selection, test development, and educational measurement.

Ernest J. McCormick, after working for two years with the Cotton Garment Code Authority in New York City, joined the USES in 1935 where he served as Chief of the Planning Unit (Koppes, 1999). After subsequent stints with the Bureau of the Census, the Selective Service System, and the Bureau of Naval Personnel, he joined the faculty at Purdue University. At Purdue, he pioneered in the development of structured job analysis methodology based on generic "worker-oriented" descriptors, from which he derived general job dimensions or "components" with applications in such areas as ability-requirement estimation, job evaluation and classification, performance evaluation, and person-job matching (McCormick, 1959; McCormick & Jeanneret, 1988). This line of research culminated in the development of the Position Analysis Questionnaire (PAQ; McCormick, Jeanneret, & Mecham, 1972), the best known and most researched instrument of its genre and the precursor to several subsequent general job analysis questionnaires (Cornelius, Hakel, & Sackett, 1979; Cunningham, Boese, Neeb, & Pass, 1983; Cunningham, Wimpee, & Ballentine, 1990; Harvey, 1991a, 1991b). The PAQ and some of its progeny contributed to the recent development of the generalized work activities in the Department of Labor's O*NET system (Jeanneret, Borman, Kubisiak, & Hanson, 1999). McCormick authored the books *Job Analysis* (McCormick, 1979), *Industrial Psychology* (McCormick & Tiffin, 1974), and *Human Engineering* (McCormick, 1957), one of the early works in that field.



Sidney A. Fine joined the USES in 1940 (working initially under Carroll Shartle) where he was instrumental in forming the Functional Occupational Classification Project (FOCP). An approach known as Functional Job Analysis (FJA) emerged from the FOCP research findings as organized under a conceptual framework developed by Fine (1955). The FJA approach involves a structured procedure for writing task statements, which are then rated in terms of (a) the worker's level of involvement with the three functional hierarchies of Things, Data, and People and (b) the levels of reasoning, math, and language required. The functional hierarchies were incorporated into the third and fourth editions of the *Dictionary of Occupational Titles* and subsequently into the *Canadian Classification and Dictionary of Occupations* (Fine & Getakate, 1995). After 20 years of service with the USES, Fine continued the development of FJA at the Upjohn Institute for Employment Research, the Advanced Research Resources Organization, and through private consulting (Fleishman, 1999). The FJA approach has been applied in such areas as test development, job design, performance appraisal, training, and job evaluation. In collaboration with others, Fine has authored two recent books on FJA (Fine & Cronshaw, 1999; Fine & Getkate, 1995).

Ernest S. Primoff, along with Sidney Fine, joined the USES in 1940, later transferring to the U.S. Civil Service Commission (now the Office of Personnel Management) where he remained for a substantial part of his career. While serving with the Civil Service Commission, Primoff developed the Job Element Method (JEM) for systematically determining job requirements (Primoff & Eyde, 1988). He carried out pioneering work in the application of the JEM to develop job-specific personnel selection tests and to synthetically validate standardized tests for selection purposes. His synthetic validation procedure involved the estimation of (a) a job's requirements for a specified set of job elements representing different worker behaviors and attributes and (b) the weights of standardized tests on the job elements. These values were then combined to derive "J-coefficients" representing estimated test validities (Primoff, 1957, 1959). The JEM has also been applied in the development of training programs, performance rating systems, and experience and training accrediting plans.

John L. Holland began his career in the field of vocational counseling at Western Reserve University and with the Veterans Administration, later joining the faculty at Johns Hopkins University (Holland, 1999). In a 1959 journal article, he introduced his theory of personality types and work environments

(Holland, 1959), which he elaborated in his subsequent book, *Making Vocational Choices* (Holland, 1973, 1985a, 1997). The heuristic value and empirical support of Holland's theory is unsurpassed in the field of vocational psychology (G. Gottfredson, 1999; L. Gottfredson and Richards, 1999). The theory's constructs have been operationalized in two self-report questionnaires, the Vocational Preference Inventory (Holland, 1967, 1985b) and the Self Directed Search (Holland, 1970; Holland, Fritzsche, & Powell, 1994), and have been applied more recently to the description and classification of jobs and occupations through the *Dictionary of Holland Occupational Codes* (G. Gottfredson & Holland, 1996; Gottfredson, Holland, & Ogawa, 1982) and the Position Classification Inventory (G. Gottfredson & Holland, 1991). In combination, these instruments are designed to promote compatible relationships between people and their work environments. The Holland model has been incorporated recently into the Department of Labor's O*NET system (Rounds, Smith, Hubert, Lewis, & Rivkin, 1998; Sager, 1999).

Edwin A. Fleishman has made a number of important pioneering contributions in identifying ability and other requirements of work and providing concepts and methods for measuring them. At the Personnel Research Board, The Ohio State University, he identified dimensions for describing leadership behavior and developed the Supervisory Behavior Description Questionnaire (Fleishman, 1953) to analyze managerial job requirements. At the Air Force Skills Component Research Laboratory and subsequently as a professor at Yale University, he combined experimental and factor analytic methods to identify and measure the fundamental psychomotor abilities required in complex task performances (Fleishman, 1958, 1964, 1972; Fleishman & Hempel, 1956). While director of the American Institutes for Research in Washington, he established the "taxonomy project" under support of the U.S. Department of Defense (Fleishman, 1975, 1982). This effort culminated in the book *Taxonomies of Human Performance* (Fleishman & Quaintance, 1984), which established the centrality of task constructs in describing human behavior and provided criteria for developing and evaluating task classifications. Another outgrowth of this work was the development of the Fleishman Job Analysis Survey (F-JAS) based on his taxonomy of cognitive, psychomotor, physical, and sensory-motor abilities (Fleishman, 1992). While president of the Advanced Research Resources Organization and later as professor at George Mason University, Fleishman directed numerous applications of the F-JSAS in a wide variety of work settings and published the *Handbook of Human Abilities* (Fleishman & Reilly,



1992), which provides definitions of the abilities in his taxonomy along with examples of jobs and tasks that require them and tests that measure them. Fleishman's taxonomy and measurement system has been incorporated recently into the U.S. Department of Labor's O*NET system (Costanza, Fleishman, & Marshall-Mies, 1999; Fleishman, Costanza, & Marshall-Meis, 1999).

Raymond E. Christal, in 1952, joined the Air Force Human Resources Laboratory (AFHRL) in San Antonio, Texas, where he worked for most of his professional career. In collaboration with colleagues at the AFHRL (now the Human Resources Directorate of the Armstrong Laboratory), Christal developed the job-task inventory method, a structured job-analysis procedure that has seen widespread use in the military, public, and private sectors (Christal, 1974; Christal & Weissmuller, 1988; Morsh, Madden, & Christal, 1961). Under this approach, incumbents or subject matter experts are presented with a comprehensive list of task statements with instructions to check the tasks that are performed in the job and then rate those tasks on a relative time-spent scale (and occasionally on a relative learning-difficulty scale). Combined with a powerful software package, the Comprehensive Occupational Data Analysis Programs (CODAP; Christal & Weissmuller, 1988; Phalen & Mitchell, 1993), the job-task inventory technique has proved to be a very useful tool in the development of training programs. It has also been used in determining personnel qualification requirements, identifying job types, and developing performance appraisal and job evaluation systems. In addition to his significant role in disseminating the job-task inventory technique throughout the military services and government, Christal helped introduce the method to education, business, and industry (Christal, 1970; Gael, 1983).

Donald G. Paterson, Rene V. Dawis, Lloyd H. Lofquist, and others at the University of Minnesota carried out a long line of research on occupational trait requirements. In the 1920s, Paterson initiated a program in counseling services at Minnesota that provided a model for programs at other institutions and a training ground for many leaders in the field, including, among others, Lloyd Lofquist and Rene Dawis (Super & Bohn, 1970). Within that setting, Paterson and his associates developed the Minnesota Occupational Rating Scales and an accompanying counseling profile providing ability-requirement estimates for 432 occupations (Crites, 1969; Paterson, Gerken, & Hahn, 1941, 1953; Shartle, 1952). After earning their doctorates at Minnesota, Dawis and Lofquist joined the faculty there, where in collaboration with their associates

(George W. England, David J. Weiss, and others) they initiated the Work Adjustment Project, a long-range research and development effort oriented toward vocational counseling. An important product of that effort was the Theory of Work Adjustment, the project's overarching conceptual framework, which relates the characteristics of the individual to those of the work environment (Dawis, English, & Lofquist, 1964; Dawis, Lofquist, & Weiss, 1968). This theory served as the framework for the development of three assessment tools: the Minnesota Importance Questionnaire (MIQ), a self-report need inventory, and the Minnesota Job Description and Satisfaction Questionnaires (MJDQ and MSQ), two companion devices for describing the reinforcement characteristics of the job and the individual's satisfaction with them. These instruments are described in two books, *Adjustment to Work* (Lofquist & Dawis, 1969) and *A Psychological Theory of Work Adjustment* (Dawis & Lofquist, 1983), and well as in various reports published under the *Minnesota Studies in Vocational Rehabilitation*. The MJDQ and MIQ, the two most researched instruments of their kind, have recently been adapted for use in the Department of Labor's O*NET system (McCloy et al., 1999; Sager, 1999).

Sidney Gael began his professional career in 1959 as a research psychologist with the U.S. Air Force at Wright-Patterson AFB, where he focused on the determination of personnel requirements and training needs for aircraft and space systems. While employed by the Air Force, he participated in a USAF educational program for civil service employees that enabled him to earn his doctorate in industrial psychology. Subsequently, he joined the American Telegraph and Telephone (AT & T) Personnel Research Organization and worked for the Bell System and its affiliated companies for 28 years, after which he entered private practice. At AT & T, Gael initiated and directed the development of the Work Performance Survey System (WPSS), which included structured procedures for constructing and administering task inventory questionnaires, along with a software system for analyzing the resultant data. One of the first adaptations of the military job-task inventory method to civilian use, the WPSS has proved useful in supporting a variety of human resource functions in such areas as employment and placement, training, and performance evaluation (Gael, 1977). Based on his experience with the WPSS, Gael authored a book titled *Job Analysis* (Gael, 1983) to serve as a procedural guide for carrying out job-task inventory studies. Subsequently, he undertook the monumental task of editing the two-volume *Job Analysis Handbook for Business, Industry, and Government* (Gael, 1988). The *Handbook* is the



most comprehensive source of information available on a wide variety of job analysis methods and is perhaps the most valuable single contribution to the literature in this field to date.

These and other pioneers have laid a good foundation for the systematic analysis and study of human work. However, the world of work and the encompassing society are undergoing dramatic change, and it is incumbent upon the field's following generation to keep it abreast of the times.

Much has been said and written of late about the information revolution and its impact on the economy, the workplace, and the culture in general. But, in a sense, much of human history can be characterized as an information revolution. Paleoanthropologists have determined that some 100,000 years ago, the Neanderthals living in the Levantine (eastern Mediterranean) region were joined by in-migrating anatomically modern *H. sapiens* and that for a subsequent 60,000 thousand years or so, there was little difference in the tools and sites of these two coexisting hominid species (Tattersall & Matternes, 2000). Toward the latter part of that period, however, the sophistication of *H. sapiens'* tools, weapons, and other artifacts began to surpass that of *H. neanderthalensis*, to the misfortune of the Neanderthals, who abruptly disappeared from the Levant and, soon thereafter, from their last remaining refuge in Europe as well.² A likely explanation for the sudden divergence between the two species lies in the emergence of language among modern *H. sapiens*, accompanied by a quantum jump in their cognitive (or information-processing) capabilities (Tattersall & Matternes, 2000)□for, as aptly put by one of my former professors, "Words are the handles that we use to get hold of concepts" (Owens, 1961).

The rest, as they say, is history. The ensuing years (a mere blink in evolutionary terms) have seen a rapid succession of advances in our information-processing capabilities, marked, for example, by such milestone inventions as symbolic art, written language (and paper), numerals, mathematics, the printing press, early telecommunication, electronic computers, and most recently, electronic communication and the Internet system. Interspersed among these advances have been countless technological innovations, which though products of our information-processing capabilities, have served in turn to further those capabilities. As noted by Davidson and Rees-Mogg (1993), "Many aspects of the way we view the world are roundabout consequences of technology" (p. 261).

Thus, just as the introduction of the clock and telescope in the 17th Century changed our thinking about the universe, the advent of high-speed computers is now changing our thinking about an array of subjects in the physical, biological, and social sciences and technologies (as exemplified in recent genomic research supported by the new field of bioinformatics; Hall, 2000). This interactive phenomenon is growing at an ever-increasing rate.

The impact of the information-based and microtechnologies, along with increased market competition, has already been felt in the workplace, as reflected in such concepts and practices as: flattening of the organizational hierarchy, downsizing, outsourcing, cross-training, self-managing work teams, temporary tasks and teams, electronic information processing and communication, electronic performance monitoring, telecommuting and the home office, virtual organizations, videoconferencing, distance learning, just-in-time systems, and product customization. The traditional concept of "job" is being questioned as too static in light of the flexibility now required of organizations and their employees in response to constantly shifting marketplace demands. For that reason, Levine and Sanchez (1999) propose discarding the 20th Century term "job analysis" in favor of the more general term, "work analysis."³ From the individual worker's perspective, the new work environment will place an increasing emphasis on the information-processing and social skills over the physical skills. Individual success will depend on adaptation to change and an orientation toward life-long learning. Fortunately, we have proved ourselves to be a very adaptive species. Even so, we are seeing some changes in the workplace that may be doing violence to our basic nature, as suggested by recent findings linking work-related stress to various emotional and psychosomatic disorders (Berry, 1998; Schultz & Schultz, 1998).

The transition from the industrial to the information age and its related economic impact present a challenge to those who specialize in the study of human work. A dynamic world of work cannot be adequately described and explained by a static discipline. There is a pressing need for new methods, constructs, and theories, and I fear that we may be falling behind the curve. Kitson (as cited by Shartle, 1952) once proposed a multidisciplinary approach to the study of occupations, involving all of the behavioral and social sciences as well as engineering and education. Unfortunately, Kitson's thinking was ahead of his time; at best, his vision has been only minimally realized to date. But now might be a good time to revisit this idea. There is merit in the argument that an interactive, cross-



fertilizing relationship among the disciplines would promote a fuller understanding of the world of work than could be achieved solely through their isolated individual efforts. A few years back, my colleagues and I proposed that a multidisciplinary science and technology of human work could serve as a useful interface between the established disciplines and the economic structure, better harnessing their efforts to practical workforce and economic development (Cunningham, 1996; Cunningham, Drewes, & Powell, 1995). A similar position was adopted recently by a committee of recognized professionals and scholars from several disciplines (Committee on Techniques for the Enhancement of Human Performance, 1999). The proposed multidisciplinary approach to the study of work might find some linkage with the emerging interest in a science of human environments (L. Gottfredson & Richards, 1999).

There is a need for both basic and applied research, as well as innovative methods and applications. The field should begin to address, for example, such current and emerging issues as on-line data collection, just-in-time data reporting, data mining, value-added analysis, benchmarking, decision-support modeling, team-centered measurement, and scaling, to name just a few salient problem areas. Following are some areas of potential application (Ash, 1988; Cunningham, 1996; Harvey, 1991b; Levine, 1983; McCormick, 1976, 1979; Page & Drewes, 1999):

- Personnel selection and placement
- Recruitment
- Personnel transfer and promotion
- Training
- Career development
- Performance appraisal
- Wage and salary administration
- Human resource planning and utilization
- Succession planning
- Job/work requirements specification
- Organizational development and design
- Personnel scheduling
- Efficiency analysis
- Job design/restructuring
- Tool and equipment design
- Regulatory compliance
- Health and safety administration
- Career exploration and guidance
- Labor-management negotiations
- Occupational education
- Employment counseling and placement
- Occupational standards and competency certification
- Disability determination
- Occupational rehabilitation

- Unemployment compensation
- Job/work description
- Job and occupational classification
- Workforce development
- Worker mobility analysis
- Labor force and labor market analysis
- Occupational statistics
- Research

The mission of the journal *Ergometrika* is to support a 21st Century multidisciplinary approach to the analysis and study of human work. The journal will publish articles under three headings: Research and Theory (including basic and applied research as well as theoretical or conceptual treatises), Exemplary Applications (illustrating sound practical uses and innovative technology), and Notes and News (featuring current happenings, coming events, book reviews, new laws, court cases, the Washington scene, etc.). We anticipate that consistent with the journal's title, much of the reported research will employ quantitative methodology; but we encourage all systematic approaches, fully recognizing that methodological appropriateness depends on a study's purpose, nature, and context. Submissions are invited and should be sent by e-mail to Dr. Jimmy Mitchell.

At least initially, *Ergometrika* will be available free of charge at the web-site address. Anyone wishing to join a formal list of subscribers (at no charge) should contact Dr. Mitchell. Subscribers will be notified by e-mail whenever new articles are posted. It seems especially fitting that at the dawn of the information age, the journal should be offered through an electronic medium. In fact, it is only because of the Internet that the journal is possible.

This is an entirely new venture for the editors, who have limited experience in publishing. A number of decisions regarding the journal will be made on the fly. However, we have been fortunate in recruiting a distinguished editorial board, which in addition to providing us with much needed assistance and advice, should lend *Ergometrika* some immediate credibility.

FOOTNOTES

¹ Many others have made important contributions to 20th Century work analysis. More recent contributors will bear the primary responsibility for carrying the field into the 21st century, when their work will be more fully recognized.

² Recent DNA research casts serious doubt on the theory that modern *H. sapiens* absorbed *H.*



neanderthalensis through inter-mating (The Associated Press, 2000).

³ Interestingly, the term "work analysis" was used by Frederick Taylor in the early 1900s but was soon replaced by terms aimed more at the level of specificity or generality of the entities being analyzed, such as "task analysis," "job analysis," and "occupational analysis" (Ash, 1988; McCormick, 1979).

ACKNOWLEDGEMENTS

I thank Drs. Donald W. Drewes, Edwin A. Fleishman, Sidney Gael, and Jimmy L. Mitchell for their generous advice and assistance in the preparation of this article.

REFERENCES

Ash, R.A. (1988). Job analysis in the world of work. In S. Gael (Ed.), *The job analysis handbook for business, industry, and government* (pp. 3-13). New York: Wiley.

Barnes, R.M. (1940). *Motion and time study* (2nd ed.). New York: Wiley.

Berry, L.M. (1998). *Psychology at work: An introduction to industrial and organizational psychology* (2nd ed.). Boston: McGraw-Hill.

Bingham, W.V. (1939). Halo, invalid and valid. *Journal of Applied Psychology*, 23, 221-228.

Bingham, W.V., & Moore, B.V. (1941). *How to interview*. New York: Harper.

Blum, M.L., & Naylor, J.C. (1968). *Industrial psychology: Its theoretical and social Foundations* (Rev. ed.). New York: Harper & Row.

Bownas, D.A., & Bernardin, H.J. (1988). Critical incident technique. In S. Gael (Ed.), *The job analysis handbook for business, industry, and government* (pp. 1120-1137). New York: Wiley.

Christal, R.E. (1970). Implications of Air Force occupational research for curriculum Design. In B.B. Smith and J. Moss, Jr. (Eds.), *Report of a seminar: Process and techniques of vocational curriculum development*. Minneapolis: Minnesota Research Coordinating Unit for Vocational Education, University of Minnesota.

Christal, R.E. (1974). *The United States Air Force occupational research project* (Report No. AFHRL-TR-73-75). Lackland AFB, TX: Occupational Research Division. (DTIC No. AD-774 574)

Christal, R.E., & Weissmuller, J.J. (1988). Job-task inventory analysis. In S. Gael (Ed.), *The job analysis handbook for business, industry, and government* (pp. 1036-1050). New York: Wiley.

Committee on Techniques for the Enhancement of Human Performance: Occupational Analysis. (1999). *The changing nature of work: Implications for occupational analysis*. Washington, DC: National Academy Press.

Cornelius, E.T., Hakel, M.D., & Sackett, P.R. (1979). A methodological approach to job classification for performance appraisal purposes. *Personnel Psychology*, 32, 283-297.

Costanza, D.P., Fleishman, E.A., & Marshall-Mies, J. (1999). Knowledge. In N.G. Peterson, M.D. Mumford, W.C. Borman, P.R. Jeanneret, & E.A. Fleishman (Eds.), *An occupational information system for the 21st century: The development of O*NET* (pp. 71-90). Washington, DC: American Psychological Association.

Crites, J.O. (1969). *Vocational psychology: The study of vocational behavior and development*. New York: McGraw-Hill.

Cunningham, J.W. (1971). *"Ergometrics": A systematic approach to some educational Problems* (Report No. 2 of the Ergometric Research and Development Series, under Grant No. OEG-2-7-070348-2698 with the Office of Education, U.S. Department of Health, Education, and Welfare). Raleigh: North Carolina State University, Center for Occupational Education. (ERIC Document Reproduction Service No. ED 067 443; also abstracted in *JSAS Catalog of Selected Documents in Psychology*, 1974, 4, 144-145, Ms. No. 804)

Cunningham, J.W. (1996). Generic job descriptors: A likely direction in occupational Analysis. *Military Psychology*, 8, 247-262.

Cunningham, J.W. (1988). Occupation Analysis Inventory. In S. Gael (Ed.), *The job analysis handbook for business, industry, and government* (pp. 975-990). New York: Wiley.

Cunningham, J.W., Boese, R.R., Neeb, R.W., & Pass, J.J. (1983). Systematically derived work



dimensions: Factor analyses of the Occupation Analysis Inventory. *Journal of Applied Psychology*, 68, 232-252.

Cunningham, J.W., Drewes, D.W., & Powell, T.E. (1995). Framework for a revised Standard Occupational Classification (SOC). In Standard Occupational Classification Revision Policy Committee (D. Stevens, Ed.), *Seminar on research findings* (pp. 57-165). Washington, DC: U.S. Department of Labor. (U.S. Government Printing Office No. 1995-398-319/40067)

Cunningham, J.W., Wimpee, W.E., & Ballentine, R.D. (1990). Some general dimensions of work among U.S. Air Force enlisted occupations. *Military Psychology*, 2, 33-45.

Davidson, J.D., & Rees-Mogg, L.W. (1993). *The great reckoning*. New York: Simon & Schuster.

Dawis, R.V., England, G.W., & Lofquist, L.H. (1964). *A theory of work adjustment* (Minnesota Studies in Vocational Rehabilitation: XV, under support of the U.S. Department of Health, Education, and Welfare). Minneapolis: Industrial Relations Center, University of Minnesota.

Dawis, R.V., & Lofquist, L.H. (1983). *A psychological theory of work adjustment*. Minneapolis: University of Minnesota Press.

Dawis, R.V., Lofquist, L.H., & Weiss, D.J. (1968). *A theory of work adjustment: A revision*. (Minnesota studies in Vocational Rehabilitation: XXIII, under support of the U.S. Department of Health, Education, and Welfare). Minneapolis: Industrial Relations Center, University of Minnesota.

Droege, R.C. (1988). Department of Labor job analysis methodology. In S. Gael (Ed.), *The job analysis handbook for business, industry, and government* (pp. 993-1018). New York: Wiley.

Ferguson, L. (1952). A look across the years, 1920-1950. In L.L. Thurstone (Ed.), *Applications of psychology: Essays to honor Walter V. Bingham* (pp.1-17). New York: Harper.

Fine, S.A. (1955). A structure of worker functions. *Personnel and Guidance Journal*, 34, 66-73.

Fine, S.A. (1988). Functional job analysis. In S. Gael (Ed.), *The job analysis handbook for business,*

industry, and government (pp. 1019-1035). New York: Wiley.

Fine, S.A., & Cronshaw, S.F. (1999). *Functional job analysis: A foundation for human resources management*. Mahwah, NJ: Lawrence Erlbaum.

Fine, S.A., & Getkate, M. (1995). *Benchmark tasks for job analysis: A guide for functional job analysis (FJA) scales*. Mahwah, NJ: Lawrence Erlbaum.

Flanagan, J.C. (1949). Critical requirements: A new approach to employee evaluation. *Personnel Psychology*, 2, 419-425.

Flanagan, J.C. (1954). The critical incident technique. *Psychological Bulletin*, 51, 327-358.

Fleishman, E.A. (1953). The description of supervisory behavior. *Journal of Applied Psychology*, 37, 1-6.

Fleishman, E.A. (1958). Dimensional analysis of movement reactions. *Journal of Experimental Psychology*, 55, 438-453.

Fleishman, E.A. (1964). *The structure and measurement of physical fitness*. Englewood Cliffs, NJ: Prentice-Hall.

Fleishman, E.A. (1972). Structure and measurement of psychomotor abilities. In R.N.Singer (Ed.), *The psychomotor domain: Movement behavior*. Philadelphia: Lea & Febinger.

Fleishman, E.A. (1975). Toward a taxonomy of human performance. *American Psychologist*, 30, 1127-1149.

Fleishman, E.A. (1982). Systems for describing human tasks. *American Psychologist*, 37, 821-834.

Fleishman, E.A. (1992). *Fleishman Job Analysis Survey (F-JAS)*. Potomac, MD: Management Research Institute, Inc.

Fleishman, E.A. (1999). Series forward. In S.A. Fine & S.F. Cronshaw, *Functional job analysis* (pp. ix-xi). Mahwah, NJ: Lawrence Erlbaum.

Fleishman, E.A., Costanza, D.P., & Marshall-Mies, J. (1999). Abilities. In N.G. Peterson, M.D. Mumford, W.C. Borman, P.R. Jeaneret, & E.A. Fleishman (Eds.), *An occupational information system for the 21st century: The development of O*NET* (pp. 175-



- 196). Washington, DC: American Psychological Association.
- Fleishman, E.A., & Hempel, W.E., Jr. (1956). Factorial analysis of complex psychomotor performance and related skills. *Journal of Applied Psychology*, 40, 96-104.
- Fleishman, E.A., & Quaintance, M.K. (1984). *Taxonomies of human performance: The description of human tasks*. Potomac, MD: Management Research Institute, Inc..
- Fleishman, E.A., & Reilly, M.E. (1992). *Handbook of human abilities: Definitions, measurements, and job task requirements*. Potomac, MD: Management Research Institute, Inc.
- Gael, S. (1977). Development of job task inventories and their use in job analysis research. *JSAS Catalog of Selected Documents in Psychology*, 7, 25.
- Gael, S. (1983). *Job analysis: A guide to assessing work activities*. San Francisco: Jossey-Bass.
- Gael, S. (Ed.). (1988). *The job analysis handbook for business, industry, and government*. New York: Wiley.
- Ghiselli, E.E., & Brown, C.W. (1955). *Personnel and industrial psychology*. New York: McGraw-Hill.
- Gilbreth, F.B. (1911). *Motion study*. New York: Van Nostrand.
- Gilbreth, F.B., & Gilbreth, L.M. (1916). *Fatigue study*. New York: Sturgis & Walton.
- Gilbreth, F.B., & Gilbreth, L.M. (1917). *Applied motion study: A collection of papers on the efficient method to industrial preparedness*. New York: MacMillan.
- Gilbreth, L.M. (1998). *As I remember: An autobiography*. Norcross, GA: Engineering & Management Press.
- Gini, A. (2000). *My job, my self: Work and the creation of the modern individual*. New York: Routledge.
- Gottfredson, G.D. (1999). John L. Holland's contributions to vocational psychology: A Review and evaluation. *Journal of Vocational Behavior*, 55, 15-40.
- Gottfredson, G.D., & Holland, J.L. (1991). *The Position Classification Inventory: Professional manual*. Odessa, FL: Psychological Assessment Resources.
- Gottfredson, G.D., & Holland, J.L. (1996). *Dictionary of Holland occupational codes* (3rd ed.). Odessa, FL: Psychological Assessment Resources.
- Gottfredson, G.D., Holland, J.L., & Ogawa, D.K. (1982). *Dictionary of Holland occupational codes*. Palo Alto, CA: Consulting Psychologists Press.
- Gottfredson, L.S., & Richards, J.M., Jr. (1999). The meaning and measurement of environments in Holland's theory. *Journal of Vocational Psychology*, 55, 57-73.
- Gove, P.B. (Ed.). (1968). *Webster's third new international dictionary of the English Language: Unabridged*. Springfield, MA: G. & C. Merriam Co.
- Hall, D. (2000, April 2). Colleges bank on science. *The News and Observer*, pp. 1A, 16A, Raleigh, NC.
- Harvey, R.J. (1991a). *The Common Metric Questionnaire (CMQ): A job analysis system*. San Antonio, TX: Psychological Corporation.
- Harvey, R.J. (1991b). Job analysis. In M.D. Dunnette & L.M. Hough (Eds.), *Handbook of industrial and organizational psychology* (2nd ed., Vol. 2, pp. 71-164). Palo Alto, CA: Consulting Psychologists Press.
- Holland, J.L. (1959). A theory of vocational choice. *Journal of Counseling Psychology*, 6, 35-45.
- Holland, J.L. (1967). *Manual for the Vocational Preference Inventory* (6th rev.). Palo Alto, CA: Consulting Psychologists Press.
- Holland, J.L. (1970). *The Self-Directed Search for career planning*. Palo Alto, CA: Consulting Psychologists Press.
- Holland, J.L. (1973). *Making vocational choices: A theory of careers*. Englewood Cliffs, NJ: Prentice-Hall.
- Holland, J.L. (1985a). *Making vocational choices: A theory of vocational personalities and work environments* (2nd ed.). Englewood Cliffs, NJ: Prentice-Hall.

- Holland, J.L. (1985b). *Manual for the Vocational Preference Inventory* (Rev. ed.). Odessa, FL: Psychological Assessment Resources.
- Holland, J.L. (1997). *Making vocational choices: A theory of vocational personalities and work environments* (3rd ed.). Englewood Cliffs, NJ: Prentice-Hall.
- Holland (1999). Resume. *Journal of Vocational Behavior*, 55, 5-14.
- Holland, J.L., Fritzsche, B.A., & Powell, A.B. (1994). *The Self-Directed Search technical manual*. Odessa, FL: Psychological Assessment Resources.
- Jeanneret, P.R., Borman, W.C., Kubisiak, U.C., & Hanson, M.A. (1999). Generalized work activities. In N.G. Peterson, M.D. Mumford, W.C. Borman, P.R. Jeanneret, & E.A. Fleishman (Eds.), *An occupational information system for the 21st century: The development of O*NET* (pp. 105-126). Washington, DC: American Psychological Association.
- Koppes, L.L. (1999). Ideal of science: Persons behind the SIOP awards. *The Industrial Psychologist*, 36, 75-86.
- Levine, E.L. (1983). *Everything you always wanted to know about job analysis*. Tampa, FL: Mariner Typographers.
- Levine, E.L., & Sanchez, J.I. (1999). Changes in the nature of work and the evaluation of job analysis methods. In Mitchell, J.L., Bennett, W., & Strickland, W.J. (Chairs), *Current and future trends in job analysis systems and technologies: Studying the world of work in AD 2000 and beyond*. Symposium sponsored by the Institute for Job and Occupational Analysis, U.S. Air Force Research Laboratory, and Human Resources Research Organization; San Antonio, TX.
- Lofquist, L.H., & Dawis, R.V. (1969). *Adjustment to work*. New York: Appleton-Century-Crofts.
- McCloy, R.A., Waugh, G., Medsker, G., Wall, J., Rivkin, D., & Lewis, P. (1999). *Determining the occupational reinforcer patterns for O*NET occupational units: Volumes I (Report) and II (Appendix)*. Raleigh, NC: National Center for O*NET Development, Employment Security Commission of North Carolina.
- McCormick, E.J. (1957). *Human engineering*. New York: McGraw-Hill.
- McCormick, E.J. (1959). The development of processes for indirect or synthetic validity: III. Application of job analysis to indirect validity (A symposium). *Personnel Psychology*, 12, 402-413.
- McCormick, E.J. (1976). Job and task analysis. In M.D. Dunnette (Ed.), *Handbook of industrial and organizational psychology* (pp. 651-696). Chicago: Rand McNally.
- McCormick, E.J. (1979). *Job analysis: Methods and applications*. New York: AMACOM.
- McCormick, E.J., & Jeanneret, P.R. (1988). Position Analysis Questionnaire. In S. Gael (Ed.), *The job analysis handbook for business, industry, and government* (pp. 825-842). New York: Wiley.
- McCormick, E.J., Jeanneret, P.R., & Mechem, R.C. (1972). A study of job characteristics and job dimensions as based on the Position Analysis Questionnaire (PAQ). *Journal of Applied Psychology*, 56, 347-368.
- McCormick, E.J., & Tiffin, J. (1974). *Industrial Psychology* (6th ed.). Englewood Cliffs, NJ: Prentice-Hall.
- Meister, D. (1999). *The history of human factors and ergonomics*. Mahwah, NJ: Lawrence Erlbaum Associates.
- Mitchell, J.L. (1988). History of job analysis in military organizations. In S. Gael (Ed.), *The job analysis handbook for business, industry, and government* (pp. 30-36). New York: Wiley.
- Mitchell, J.L., Bennett, W., & Strickland, W.J. (Chairs). (1999, May). *Current and future trends in job analysis systems and technologies: Studying the world of work in AD 2000 and beyond*. Symposium sponsored by the Institute for Job and Occupational Analysis, the U.S. Air Force Research Laboratory, and the Human Resources Research Organization; San Antonio, TX.
- Mitchell, J.L., & Driskill, W.E. (1996). Military job analysis: A historical perspective. *Military Psychology*, 8, 119-142.
- Morsh, J.E., Madden, J.M., & Christal, R.E. (1961). *Job analysis in the United States Air Force* (Report No. WADD-TR-61-113). Lackland Air Force Base,



TX: Personnel Laboratory, Wright Air Development Division.

Munsterberg, H. (1913). *Psychology and industrial efficiency*. Boston: Houghton Mifflin.

Owens, W.A., Jr. (1961, February 9). Course lecture in differential psychology. Purdue University, W. Lafayette, IN.

Page, R.C., & Drewes, D.W. (1999). Putting O*NET to work in your human resource applications. In D.W. Drewes, M.A. Wilson, & J.W. Cunningham (Eds.), *O*NET work analysis fieldbook: A guide for defining the world of work* (pp. 37-86). Unpublished manuscript, Raleigh, NC: National Center for O*NET Development.

Paterson, D.G., Gerken, C.D., & Hahn, M.E. (1941). *The Minnesota Occupational Rating Scales and Counseling Profile*. Chicago: Science Research Associates.

Paterson, D.G., Gerken, C.D., & Hahn, M.E. (1953). *Revised Minnesota Occupational Rating Scales*. Minneapolis: University of Minnesota.

Peterson, N.G., Mumford, M.D., Borman, W.C., Jeanneret, P.R., & Fleishman, E.A. (Eds.). (1999). *An occupational information system for the 21st Century: The development of O*NET*. Washington, DC: American Psychological Association.

Phalen, W.J., & Mitchell, J.L. (1993). Innovations in occupational measurement technology for the U.S. military. In *Proceedings of the Eight International Occupational Analysts Workshop* (pp. 12-16). San Antonio, TX: U.S. Air Force Occupational Measurement Squadron.

Primoff, E.S. (1957). The J-coefficient approach to jobs and tests. *Personnel Administration*, 20, 34-40.

Primoff, E.S. (1959). The development of processes for indirect or synthetic validity: IV. Empirical validations of the J-coefficient. *Personnel Psychology*, 12, 413-418.

Primoff, E.S., & Eyde, L.D. (1988). Job element analysis. In S. Gael (Ed.), *The job analysis handbook for business, industry, and government* (pp. 807-824). New York: Wiley.

Primoff, E.S., & Fine, S.A. (1988). A history of job analysis. In S. Gael (Ed.), *The job analysis*

handbook for business, industry, and government (pp. 14-29). New York: Wiley.

Rounds, J.B., Jr., Smith, T., Hubert, L., Lewis, P., & Rivkin, D. (1999). *Development of occupational interest profiles for the O*NET: Volumes I (Report) and II (Appendices)*. Raleigh, NC: National Center for O*NET Development, Employment Security Commission of North Carolina.

Sager, C.E. (1999). Occupational interests and values. In N.G. Peterson, M.D. Mumford, W.C. Borman, P.R. Jeanneret, & E.A. Fleishman (Eds.), *An occupational information system for the 21st century: The development of O*NET* (pp. 197-212). Washington, DC: American Psychological Association.

Schultz, D.P., & Schultz, S.E. (1996). *A history of modern psychology* (6th ed.). Fort Worth, TX: Hartcourt Brace.

Schultz, D.P., & Schultz, S.E. (1999). *Psychology and work today: An introduction to industrial and organizational psychology* (7th ed.). Upper Saddle River, NJ: Prentice-Hall.

Scott, W.D., Clothier, R.C., & Spriegel, W.R. (1954). *Personnel management* (5th ed.). New York: McGraw-Hill.

Sennett, R. (1998). *The corrosion of character: The personal consequences of work in the new capitalism*. New York: W.W. Norton.

Shartle, C.L. (1952). *Occupational information* (2nd ed.). New York: Prentice-Hall.

Shartle, C.L., & Stogdill, R.M. (1957). *Work Analysis Forms*. Columbus, OH: Bureau of Business Research, The Ohio State University.

Super, D.E., & Bohn, M.J. (1970). *Occupational psychology*. Belmont, CA: Wadsworth.

Tattersall, I., & Matternes, J.H. (2000, January). Once we were not alone. *Scientific American*, 56-62.

Taylor, F.W. (1911a). *The principles of scientific management*. New York: Harper.

Taylor, F.W. (1911b). *Common sense applied to motion and time study*. New York: Harper.



The Associated Press. (2000, March 29). Neanderthal DNA casts doubt on link. *The News and Observer*, p. 17A, Raleigh, NC.

Thurstone, L.L. (1952). Preface. In L.L. Thurstone (Ed.), *Applications of psychology: Essays to honor Walter V. Bingham* (pp. i-ix). New York: Harper.

Trattner, M.H., Fine, S.A., & Kubis, J.F. (1955). A comparison of worker requirement ratings made by reading job descriptions and by direct observation. *Personnel Psychology*, 8, 183-194.

U.S. Department of Labor. (1956). *Estimates of worker trait requirements for 4000 jobs*. Washington, DC: U.S. Government Printing Office.

U.S. Department of Labor, Employment and Training Administration. (1991). *The revised handbook for analyzing jobs*. Washington, DC: U.S. Government Printing Office.

U.S. Employment Service. (1944). *Training and reference manual for job analysis*. Washington, DC: Superintendent of Documents.

Viteles, M.S. (1923). Job specifications and diagnostic tests of job competency designed for the auditing division of a street railway company. *Psychological Clinic*, 14, 83-105.

Viteles, M.S. (1932). *Industrial psychology*. New York: W.W. Norton.

Wren, D.A., & Greenwood, R.G. (1998). *Management innovators: The people and ideas that have shaped modern business*. New York: Oxford University Press.

APPENDIX: EXERPT FROM A CITED PUBLICATION

Cunningham, J.W. (1971). *"Ergometrics": A systematic approach to some educational Problems* (Report No. 2 of the Ergometric Research and Development Series, under Grant No. OEG-2-7-070348-2698 with the Office of Education, U.S. Department of Health, Education, and Welfare). Raleigh: North Carolina State University, Center for Occupational Education. (ERIC Document Reproduction Service No. ED 067 443; also abstracted in JSAS *Catalog of Selected Documents in Psychology*, 1974, 4, 144-145, Ms. No. 804)

The following excerpt is taken from pp. 7-8 of the cited report:

In light of the increased emphasis on psychometric procedures in job analysis—in comparison to other types of procedures (e.g., written descriptions, work diaries, and films)—it would seem appropriate at this time to coin a new and more specific term for this particular approach to the study of work. One label that might suffice for this purpose is ergometrics, which could be defined as the application of psychometric principles and procedures to the study of human work. ("Erg" derives from the Greek word ergon, meaning work.) This field of investigation would draw from theories and principles of human behavior, as well as from established procedures in psychological measurement and job analysis. It would deal with at least four basic kinds of problems: (1) the definition, quantification, and classification of work variables; (2) the establishment of relationships between work variables and existing measures of human attributes (i.e., tests in the cognitive, psychomotor, and affective domains); (3) the development of measures of work-related human attributes, or behavioral potentials (such as vocational ability tests and interest scales); and (4) the study of the nature of the relationships among various work-related variables. Accordingly, research in ergometrics, like any other field of research, would involve theory building, measurement, classification, and hypothesis testing. Because of its emphasis on psychometric procedures, ergometrics might be characterized as a "nomothetic" rather than an "ideographic" approach to the study of work (Allport, 1937; Tyler, 1965); i.e., an approach emphasizing the common dimensions rather than unique characteristics of tasks, jobs, and occupations.

At this point, a distinction should be made between the terms "ergometrics" and "ergonomics." ("Nomics" derives from the Greek word nomikos, meaning law; cf. Dukes-Dobos, 1968.) Ergonomics is a term applied in Great Britain and Europe to an established field of activities that would fall under the heading "human factors engineering" in the United States (McCormick, 1970; McFarland, 1971). A definition of this field can be drawn from the following statement concerning the objective of the Ergonomics Research Society (1964):

The objective is to promote learning and advance education in the subject of the relation between man and his environment, the design of the equipment with which he works and particularly the application of anatomical, physiological, and psychological



knowledge to the problems arising from his equipment and environment. (p. 5)

Two distinctions between ergonomics and ergometrics might be drawn from the foregoing statement and the previous definition of ergometrics: (1) ergonomics places considerable emphasis on the physical and physiological aspects of work, whereas ergometrics is more concerned with the psychological aspects of work; and (2) ergonomics typically deals with work at a more molecular level than ergometrics; e.g., specific physiological, sensory, and motor responses (in relation to work performance), compared with more molar behavioral variables, such as McCormick's worker-oriented activities (McCormick, 1959, 1964). A further distinction is the one Cronbach (1957) makes between engineering psychology, which is subsumed under ergonomics (Grether, 1968), and personnel psychology, the field within which ergometrics has developed. According to Cronbach, engineering psychology, as an outgrowth of experimental psychology, focuses on group means, whereas personnel psychology relies primarily on the correlational approach and the existence of individual differences. Cronbach notes, however, that "The greatest social benefit will come from... the joint application of experimental and correlational methods" (1957, p. 679). A similar argument could be made for a complementary relationship between ergometrics and ergonomics.

APPENDIX REFERENCES

- Allport, G.W. (1937). *Pattern and growth in personality*. New York: Holt, Rinehart, and Winston.
- Cronbach, L.J. (1957). The two disciplines of scientific psychology. *American Psychologist*, 12, 671-684.
- Dukes-Dobos, F.N. (1970). The place of ergonomics in science and industry. *American Industrial Hygiene Association Journal*, 31, 565-571.
- Grether, W.F. (1968). Engineering psychology in the United States. *American Psychologist*, 23, 743-751.
- McCormick, E.J. (1959). Application of job analysis to indirect validity (in The development of processes for indirect or synthetic validity: A symposium). *Personnel Psychology*, 12, 402-413.
- McCormick, E.J. (1964). *The development, analysis, and experimental application of worker-oriented job variables* (Final report under Contract No. Nonr-1100-19 with the Office of Naval Research). West Lafayette, IN: Occupational Research Center, Purdue University.
- McCormick, E.J. (1970). *Human factors engineering*. New York: McGraw-Hill.
- McFarland, R.A. (1971). Ergonomics around the world: The United States of America. *Applied Ergonomics*, 2, 19-25.
- Tyler, L.E. (1965). *The psychology of human differences*. New York: Appleton-Century Crofts.

Editor's Note: Pagination in this article may be different from the citation source due to formatting and layout conversions

