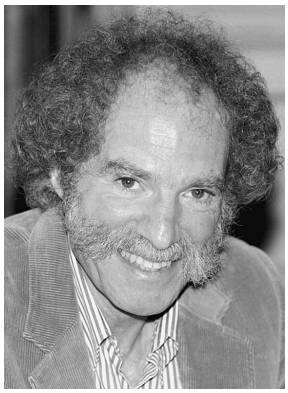

Statistics: The Next Generation

Miron L. STRAF

New technologies benefit our lives in many ways, but they can also bring increased risks, disruptions to our society, and even the malevolence of war. Statisticians can play a critical role in influencing the paths along which technology will take our society. But taking on this role requires changing our discipline, our profession, and our ASA. Change, however, is not an option; if we do not change, then technology may force change on us in detrimental ways. Understanding how to change requires a broader view of statistics as a human activity with a human purpose that must evolve within a social, or human, system. Considered as a technology, statistics is a fundamental and invaluable part of the infrastructure of other sciences. Statistics advances discoveries in other sciences. Universities and foundations must encourage interdisciplinary research as a primary contribution to our field. Our curricula must reflect modern approaches that other sciences require, and students with quantitative talents must be attracted from other disciplines. Statistics should permeate the mathematics curricula at all elementary and secondary levels, and all children should understand variability and uncertainty, how to make sense from data, and the elements involved in making decisions. In industry, we must capitalize on the importance of quality improvement programs to further contributions of statistics. From government, we need timely and accurate statistics that are relevant to the world of the future as well as to today. In particular, we must commit ourselves now to changing our 40-year-old poverty measure and improve access to government statistics with different and stronger ways to protect confidentiality. We must work toward a comprehensive, integrated network of knowledge and information systems for research on individual, social, and organizational change and for decision making by individuals, organizations, and public policy makers at all levels—local, regional, and national. In all of these directions, the ASA must foster and encourage change and, in many cases, lead the way. With the commitment and perseverance of our next generation, statistics can become a leader in the advancement of science and technology to promote human welfare.

KEY WORDS: American Statistical Association; Government statistics; Interdisciplinary research; Statistics curricula; Statistics education; Technological change.

Author's note: The following is the text of my speech to the American Statistical Association at the Joint Statistical Meetings in New York on August 13, 2002. It is included here as delivered—unrevised and unexpurgated.

1. AN ERA OF TECHNOLOGICAL CHANGE

The theme of our meeting this year is statistics in an era of technological change. We are fortunate to be alive in this era, to experience the changes brought by new technology—information, communications, biotechnology, and others—and to anticipate the changes that we will surely experience from new technologies, some heretofore unimaginable.

These new technologies will bring many benefits to our lives. But they also will bring risks. Transportation technology has brought us closer together and enabled a global economy. But it has also brought terrorism to our shores. Information and communications technologies have dramatically increased our productivity and expanded our outreach. But our greater reliance on them for economic transactions, health care, transportation, electric power distribution, and communications leads to the risks of greater consequences from widespread failures in these complex, critical systems. Biotechnology can enable us to feed the world, but at the same time increases the risks to our environment and sources of food. Genetics promises new medical therapies and a longer lifespan, but it also raises a host of ethical issues, including embryo selection and gene replacement, and portends a loss of privacy of information on our own destiny.

Today we are on the verge of even greater technological change from nanotechnology, robotics, cybernetics (including chips implanted into the human nervous system that can communicate with computers and give us superhuman abilities), and, likely before this decade is out, the ability to determine an individual's genetic sequence overnight (Bier 2000).

Take nanotechnology, for example. With the ability to manipulate individual atoms and molecules, it will be possible to build machines on the scale of human cells or to create new materials having properties that could not be developed with traditional chemistry.

Among the expected breakthroughs are quantum computers that can calculate millions—if not billions—of times faster than today's fastest supercomputers, artificial photosynthesis

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for clean energy, and human organ restoration using synthetic tissue. Nanotechnology could lead to lighter, faster, less polluting, and safer transportation vehicles. It could improve medicine, agricultural yields, desalination, and water filtration and enable highly efficient solar energy conversion. Can you begin to imagine the many ways in which statistics can contribute to advancing this technology?

From research today on this and other frontiers will come technologies that will forever change our lives. They can bring bountiful wonders, but they also can bring increased risks, disruptions to our society, and even the malevolence of war.

2. A CRITICAL ROLE FOR STATISTICS

My message to you today is that we, as statisticians, can play a critical role in influencing the paths along which technology will take our society. But it will require us to change—to change our discipline, to change our profession, and to change our ASA.

Why is it that statistics can play such a critical role? All sciences play a role in technological development. But our discipline is special, not only because it advances discoveries across the breadth of scientific disciplines and advances the development of technologies, but also because it has an important connection to the human side of scientific and technological development.

How the needs of our society are measured and articulated, how our businesses and industries respond to those needs with technological developments, how our markets and our political and legal institutions encourage or impede technologies, and how we as a society employ technology and deal with its unintended consequences—these human activities have as much to do with advancing a technology's contributions to society as does the development of the technology itself.

Statisticians are engaged in *all* of these aspects of technological development. ASA members come from educational and research institutions, laboratories and think tanks, businesses and industry, and government organizations at all levels—local, state, and national. We work in *all* scientific disciplines—the physical, natural, biological, life, and health sciences and, especially relevant to this challenge, the social and behavioral sciences. We engage in scientific research and its application through engineering and medical practice, and we inform government policies affecting our society. You see these different aspects represented here among yourselves and, in particular, among the fellows whom we have just honored.

For these reasons, I argue that there is no discipline better suited than statistics to play a leadership role in confronting the challenges of technological change. But our doing so will require us to change.

3. CHANGE IS NOT AN OPTION: THE WORLD IN 2020

I put it to you, however, that change for us is not an option. Technology and its interaction with social, political, and economic factors will force change upon us. Suppose we as a profession do not change our ways while the world around us changes. Imagine, then, *our* world in the year 2020.

It is a world without walls. Geography no longer defines where people work, where they learn, or where they transact business. Generation III of the Internet is the medium for education, decentralized work, and global commerce.

Education is individualized and continues throughout the lifespan. Academic statisticians develop and sell distance-learning courses that universities underwrite for a percentage of the profits. But the universities compete with firms attracted by the lucrative market. The largest provider of statistics courses is Michael Milken's Knowledge Universe.

Many statistics courses are centered around proprietary software. Faculty want to teach other approaches, but know their students, on graduation, will sit for the certification exam in MSP—the Microsoft Statistical Package.

The available pool of talent for students in statistics has dwindled, as those with technical abilities are drawn off to computer science and other fields. Departments in other disciplines teach their own statistics courses tailored to their discipline and customized to the individual student. Many universities have dissolved their departments of statistics.

In the past, foreign students filled the talent gap for most statistics departments. But with today's technology, foreign students can obtain a first-rate education without leaving their home country. Stanford has affiliated with the National Taiwan University to provide distance learning in statistics with interactive Web-based classrooms for its students.

Printed journals have now completely given way to online journals, which provide timely access to current research. Many statistics journals offer immediate publication without peer review. The most popular journal articles are comparative reviews of software and other statistical tools. Zagat publishes a monthly review of statistical software.

With air travel unsafe and unnecessary, statisticians have developed Web-based alternatives to large association meetings. In many statistics specialties, strong communities have formed around virtual meetings. On the first Tuesday of every month, the American Data Mining Association broadcasts, over the Internet, lectures or tutorials on recently developed methods.

The statistics discipline is fragmented into highly specialized fields. Individual statisticians have loyalty not to a profession, but rather to their own marketable skills, tools, knowledge, and experience. They have little knowledge or appreciation of work outside their specialty.

As government has focused on national security, support of basic research in statistics has been left mostly to the private sector. Unencumbered by many former regulations, businesses are now engaged in nontraditional areas, such as managing social security and, this year, with advanced communications technology, taking the decennial census.

Such a future is unlikely, but there are many plausible elements to it. Colleagues, if we do not change, then technology may change us in some of these and other ways that may be detrimental to our profession.

But, how should we change? To begin with, we must accept a different, broader view of statistics.

4. WHAT IS STATISTICS?

Many of our leaders have sought to define statistics, leaving us a legacy of countless definitions (see Bartholomew 1995). From the variety of perspectives reflected in these definitions,

one might conclude that statisticians do not even agree on what statistics is. But we do generally agree on the elements that it comprises: data; variability; uncertainty; sources of error; conceptualizing and quantifying phenomena; empirical inquiry through experiments, surveys, observational, and other studies; extraction and summary of information; inferences; and communication of results (Kruskal 1978; Fienberg and Kadane 2001).

I would like to share with you my personal definition of statistics through what I believe are its very purposes:

> To increase our understanding, to promote human welfare, and to improve our quality of life and well-being by advancing the discovery and effective use of knowledge from data.

This statement defines statistics not as a body of methods nor a collection of data, but rather as an *activity*. Statistics is the generation and effective use of knowledge from data—data with all their uncertainty, fallibility, and variability.

4.1 The Human Element

The definition reflects the human elements of statistics. Even if we pursue the science of statistics for its own sake, there is a purpose for doing so. That purpose is to increase our understanding, promote human welfare, and improve the quality of our lives. We must first acknowledge that statistics has *a human purpose*.

Another human element is that statistics and the scientific and technological discoveries it helps to spawn must evolve within a social system—*a human system*. If these discoveries are to promote human welfare, they must interact with our social framework—our political, economic, legal, and other social institutions and our systems of laws, property rights, regulations, and government policies.

Let us not forget a third human element. Statistics is *a human activity*. As humans, we are fallible. In particular, we are influenced by personal and social attitudes and values. To moderate that influence, we must commit ourselves to the scientific values of excellence, peer review, fairness, balance, openness, sharing data, verification by others, objectivity, honesty, and integrity. We must understand the suppositions and beliefs behind our work and make explicit our assumptions.

4.2 Statistics as Infrastructure for Other Sciences

"Statistics," Michael Healy (1978, p. 385) says, "may itself best be considered as a technology rather than as a science." I agree. As a technology, statistics is a fundamental and invaluable part of the infrastructure of other sciences.

For example, last year three astrophysicists published in *Science* a confirmation of the "big bang" theory of the creation of the universe (Miller et al. 2001; Miller, Nichol, and Batuski 2001). They studied the imprint of so-called "acoustic oscillations" on the distribution of matter in the universe today and showed that it was in concordance with the distribution of cosmic microwave background radiation from the early universe. This work not only provided support for the "big bang" theory, but also provided an understanding of the physics of the early universe that enabled predictions of the distribution of matter from the microwave background radiation forward and backward in time.

The discovery was made with a new statistical method, the *false-discovery rate*, for detecting the oscillations. The method was adapted through collaboration with computer scientists and with statisticians Larry Wasserman and Chris Genovese. Using this method, the team was able to make its discovery and publish it in *Science* while others were still plowing through the plethora of data. Statisticians are improving the statistical method and using it in the analysis of microarrays in statistical genetics and in other applications.

As this example illustrates, *statistics advances discoveries in other sciences*. Statisticians develop methods for particular applications and are equipped, as Healy says, "to discern that the methodological barrier blocking progress in one field of application has already been scaled in another" (Healy 1978, p. 392).

This year, C. R. Rao was honored by our President with the National Medal of Science. We all are proud that a statistician was so recognized. Rao's citation refers to the impact of his work on the physical, biological, economics, and engineering sciences, showing the importance given to statistics for enriching other sciences.

5. STATISTICS IN ACADEMIA

This view of statistics, of advancing the discovery and use of knowledge from data, especially in other sciences, has important implications for our three sectors: academia, industry, and government.

5.1 Interdisciplinary Research

The astrophysics discovery is an example of interdisciplinary research. Many scientific questions, especially those with broader impacts to our society, do not fall within the boundaries of a single academic discipline. Interdisciplinary research is the key to their investigation. Statistics has the potential to significantly further the contributions of science and technology to society through interdisciplinary research.

Because it is so relevant to other sciences, statistics can serve as an integrative force among them. Statisticians can build bridges and translate different disciplinary languages and perspectives into a common understanding about the data. But to develop statistics as a synergistic element in interdisciplinary research requires statisticians to become vital partners with other scientists and engineers.

Thus universities must encourage and reward, especially through promotion and tenure, the interactions of statisticians with scientists in other disciplines. Quality cross-disciplinary research must be looked on as a *primary* contribution to our field.

The National Science Foundation (NSF) should establish interdisciplinary programs in its research directorates that focus on data, measurement, and the development of statistical methods to advance their sciences. A model is the Methodology, Measurement, and Statistics Program in the Directorate for Social, Behavioral and Economic Sciences.

Most statistics research at the NSF is managed through a program in the mathematical sciences, just like mathematical subdisciplines, as number theory and analysis. But statistics is

no longer just a branch of mathematics. Computer and information technologies are replacing mathematics as the foundation for more and more statistics research. At the very least, the NSF should establish a division for statistics research that is separate from mathematics.

5.2 The Next Generation of Statistical Methods

Especially in this era of technological change, if statistics is to advance discovery in other sciences, we need to also apply the next generation of statistical methods. Leo Breiman (2001, p. 199) described two cultures of our field:

> One assumes that the data are generated by a given stochastic data model. The other uses algorithmic models and treats the data mechanism as unknown. The statistical community has been committed to the almost exclusive use of data models. This commitment has led to irrelevant theory, questionable conclusions, and has kept statisticians from working on a large range of interesting current problems.

P. K. Sen, this year's recipient of our prestigious Noether award, describes the new frontier of statistics as dealing with highly nonstandard problems: "The wealth of statistical tools and concepts developed during the past six decades," he concludes, "may be of very limited use in this new field.... We need to address our curricula, train our teachers, and motivate and organize our training programs to promote better understanding and interaction of statisticians... with other scientists...." (Sen 2002, p. 11).

Unless we change our culture and unless we change the curricula we teach to reflect the more modern approaches that other sciences require, then our contributions to advancing our society through science and technology will be marginal at best. But even more is at stake. We stand to lose our students, jobs, and our own statisticians to other, more exciting data-oriented sciences.

If data-analytic techniques become dominant in other fields, traditional statistics departments may become unnecessary. Driven by the plethora of new forms of data, statistical practice will explode, but our profession may implode.

If we are to change our culture and our curricula, as I believe we have to do, then first we must, as Jerry Friedman (2001, p. 9) put it, "moderate our romance with mathematics." We must recognize, especially in applications to other sciences, that empirical corroboration may advance discoveries far more than theoretical, mathematical validation.

Beyond new curricula, we must inspire and teach our students to become partners in interdisciplinary research. That requires teaching them how to communicate with other scientists and engineers.

5.3 Developing Multiple Pathways

We need to attract from other disciplines students with quantitative talents. That requires developing multiple pathways to statistics. Some students may then gravitate to statistics as a secondary degree, if not a primary one. More students may continue with a professional affiliation with statistics and influence future generations of students. We need to replace the *filter* of mathematics by a *funnel* of statistics whereby anyone with quantitative talents can enter our field from any scientific discipline or field of engineering.

Those of you who teach service courses in statistics must treat these courses with no less care than you treat those for statistics majors. With these service courses, we either interest students in our field or turn them off.

To attract more graduate students, we must promote and further develop statistics curricula for undergraduates. Moreover, because community colleges are an increasingly popular and important pathway to professions and higher education, we must also see that their students have opportunities for quality statistics education.

The most important pathway to interest students in statistics is K–12 education. Statistics should permeate the mathematics curricula at all elementary and secondary levels. We must see that children understand variability and uncertainty, how to make sense from data, and the elements involved in making decisions. We must do so not just because the concepts are important to our profession, but also because they are important to our children in their future world. And we must see that *all* children learn them, because with high-quality education, all children are capable of learning them. In these basic statistical concepts, we must see that no child is left behind.

6. STATISTICS IN INDUSTRY

The quality improvement program Six Sigma is an example of the importance of statistics being recognized at the upper echelons of management in industry. When he was chief executive officer of General Electric (GE), Jack Welch sought to recruit GE's best people in the program and foresaw those with the statistical Six Sigma training as dominating GE's management.

How can we capitalize on this newfound importance to further the contributions of statistics? First, we can recognize these programs in our own statistical community as important statistical applications. Rather than critiquing them as fads, for their hype, or for their sometimes naive use of statistics, we should recognize their purposes and seek to improve the methods.

We need to bring these programs as examples into our classrooms and encourage research on them. Through its journals, meetings, and continuing education courses, ASA could foster a community of statisticians to become or train others to become leaders in industry. In next month's *AmStat News*, Roger Hoerl (2002) discusses some of these and other methods to bring our discipline to bear on improving and advancing Six Sigma quality improvement and, at the same time, advancing the importance of statistics to technological development.

7. STATISTICS IN GOVERNMENT

If we are to advance our society through science and technology, we must understand the effects of the changes they bring through timely and accurate government statistics that are relevant to the world of today, let alone the future.

Throughout its 30-year history, the Committee on National Statistics at the National Academy of Sciences has worked to improve government statistics. From its many studies, two areas are, at least to me, most important and urgent: poverty and access to data.

7.1 The Poverty Measure

Next year will mark the 40th anniversary of the official poverty measure developed by Mollie Orshansky. We have been using effectively the same measure all these years.

Orshansky, using 1955 food-consumption data, estimated that families of three or more spent about one-third of their after-tax income on food. Taking the cheapest of four U.S. Development of Agriculture food plans that was designed for "temporary or emergency use when funds are low," she multiplied the cost of that economy food plan by three to define the minimum annual income a family would need to remain out of poverty. The thresholds set then have been updated only for inflation.

We are very different today from what we were in 1955. To begin with, we do not spend one-third of our income on food. Our standard of living has changed. Yet we measure poverty as if nothing has changed, only that prices have gone up.

Our outdated poverty measure does not account for the expenses of child care that are essential for so many working mothers. It does not account for expenses of transportation needed to get to work. It uses a before-tax definition of income to compare with thresholds developed on an after-tax basis and thus does not account for the differential effect of tax policies on low-income families. It does not distinguish among the health care needs of different families, and does not account for health insurance, which affects what families pay for health care. Moreover, our outdated measure does not reflect the differences in costs of living in different areas of our country, most notably the cost of housing.

Among so much that we have today that we did not have when our poverty measure was developed are government and private programs that provide in-kind and tax benefits to low-income families—food stamps, housing, energy assistance, Medicaid and Medicare, and Earned Income Tax Credits. Our outdated poverty measure reflects none of these. If we were to institute another program today, our poverty measure could not tell us if it were to have any effect. So how can we learn the effects of changes on the important consequence of poverty?

Do you think we would tolerate a Consumer Price Index for today based only on those goods and services that we were buying in 1955? Yet that is effectively what we do with the poverty measure.

Seven years ago, a Committee on National Statistics panel, having explored several approaches and criteria for a poverty measure, recommended revising the current one "to reflect more nearly the circumstances of the nation's families and changes in them over time" (National Research Council 1995, p. 4). Since then, the Census Bureau has been compiling and publishing several experimental measures. But the standard—the official U.S. measure of poverty—remains the same, stultified in a political quagmire.

Forty years is too long. We must commit ourselves *now* to changing the poverty measure.

7.2 Access to Data

To understand the effects of technological change and to prepare for its consequences, we need access to government statistics that are increasingly being restricted to protect confidentiality. Even government statistical agencies are restricted from obtaining data from other statistical agencies. Different, stronger ways to protect confidentiality are needed. Statistical agencies should lead in confidentiality research, in fostering legal and administrative means to protect confidentiality, and in broadening access for research and statistical purposes. We must respect respondents to our censuses and surveys by using the information they provide when it can benefit society.

To begin with, we can stop thinking in terms of setting an absolute standard of zero risk of inferring information about an individual. Because that risk is never zero, the obligation to protect confidentiality for government statistics must also be placed on all those who use them.

7.3 Vision for Government Statistics

If we are to use statistics to promote human welfare and advance the quality of our lives and well-being, then we must be guided by a different vision for government statistics. This vision encompasses a comprehensive integrated network of knowledge and information systems for research on individual, social, and organizational change and for decision making by individuals, organizations, and public policy makers at all levels—local, regional, and national.

8. THE AMERICAN STATISTICAL ASSOCIATION

I believe that all of the aforementioned changes are necessary if we are to contribute to the advancement of science, technology, and society in an era of technological change. Some of them are necessary if we are to remain viable as a profession.

We have lost positions of leadership in many fields that have had their origins in statistics, including, quality improvement, finance statistics, and machine learning and data mining, with their methods of pattern recognition and neural networks. And we have even lost leadership of K–12 statistics education.

Our ASA cannot sit idly by as statisticians in academia continue to focus on graduate education and on extending the statistical methods of a past generation. We need to develop through our journals, our meetings, and our networks a broader statistical community—nationally and internationally—one that encompasses modern statistical practice that other sciences require.

The ASA must promote and reward interdisciplinary research; be proactive in developing multiple pathways to our profession; promote new journals, especially ones on emerging applications of statistics; and advance statistical practice in industry. The ASA should foster statistics curricula for the future; encourage the development of undergraduate statistics programs, especially in community colleges; and seek the widespread adoption of statistical concepts as standards for K–12 mathematics education. The ASA should speak out against the inadequacies of our government statistics, seek ways to improve them, and foster the legislative solutions we know are needed.

Finally, we, through the ASA, must develop communities for different types of statistical research or practice, especially in such areas as Six Sigma or data mining, which we might otherwise lose. We must build these communities, not just

through more sections, but also, more importantly, on the Web (see Kim 2000).

9. THE FUTURE

My vision is of statisticians working together with scientists in other disciplines to increase their powers of observation; to further their abilities of measurement, analysis, and prediction; and to advance their discoveries and guide their responsible development into technologies that make a difference in people's lives.

The future of our discipline, our profession, and our ASA are in the hands of our next generation. Some of those among you here may embrace these changes and choose this road less traveled. The road is laden with risks. Colleagues in your organizations may shun you. Our compartmentalized academic institutions may not reward you. Bureaucracies fixed on self-preservation may impede you.

Yet if you persevere, you will succeed in making statistics a leader in the advancement of science and technology to promote human welfare. I truly believe you are capable of achieving this goal, and I wish you Godspeed.

To *all* of you of any generation: If you share this vision, if you commit yourselves to this goal, may you come to feel, as I do, that there is no greater challenge nor higher calling than to be a statistician in service to science, technology, and society.

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REFERENCES

Bartholomew, D. J. (1995), "What is Statistics?," *Journal of the Royal Statistical Society*, Ser. A, 158, part 1, 1–20.

Bier, E. (2000), "The Next Step: Devising an Ethical Blueprint for New Genetic Knowledge," *The Chronicle of Higher Education*, July 21, 2000, B6.

Breiman, L. (2001), "Statistical Modeling: The Two Cultures," *Statistical Science*, 16, 199–231.

Fienberg, S. E., and Kadane, J. B. (2001), "Statistics: The Field," in *The International Encyclopedia of the Social and Behavioral Sciences*, eds. N. J. Smelser and P. B. Baltes, Oxford, U.K.: Pergamon Press, pp. 15085–15090.

Friedman, J. H. (2001), "The Role of Statistics in the Data Revolution?," *International Statistical Review*, 69, No. 1, 5–10.

Healy, M. J. R. (1978), "Is Statistics a Science?," *Journal of the Royal Statistical Society*, Ser. A, 141, 385–393.

Hoerl, R. W. (2002), "Six Sigma: One More Chance for a Broad Leadership Role," *AmStat News*, 303, 55–58.

Kim, A. J. (2000), *Community Building on the Web: Secret Strategies for Successful Online Communities*, Berkeley, CA: Peachpit Press.

Kruskal, W. H. (1978), "Statistics: The Field," in *International Encyclopedia of Statistics*, eds. W. H. Kruskal and J. M. Tanur, New York: Free Press, pp. 1071–1093.

Miller, C. J., Genovese, C., Nichol, R. C., Wasserman, L., Connolly, A., Reichart, D., Hopkins, A., Schneider, J., and Moore, A. (2001), "Controlling the False-Discovery Rate in Astrophysical Data Analysis," *The Astronomical Journal*, 122, 3492–3505.

Miller, C. J., Nichol, R. C., and Batuski, D. J. (2001), "Acoustic Oscillations in the Early Universe and Today," *Science*, 292, 2302–2303.

National Research Council (1995), *Measuring Poverty: A New Approach*, C. F. Citro and R. T. Michael, eds., Panel on Poverty and Family Assistance: Concepts, Information Needs, and Measurement Methods, Committee on National Statistics, Washington, D.C.: National Academy Press.

Sen, P. K. (2002), "Shifting Goals and Mounting Challenges for Statistical Methodology," *Journal of Modern Applied Statistical Methods*, 1, 2–12.