

# At the Point of Need\*

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*Science as servant is the theme emphasized in this paper. In particular, the applications of science in appropriate technology for developing countries are explored. Present priorities for the funding of research and development in affluent western nations are questioned in the light of Biblical principles which emphasize the Christian's responsibility to the poor. Commitment of the Christian who is a scientist to theoretical or pure research is not at issue, but, considering the needs of people in developing countries at this point in world history, there are some extremely expensive areas of research that should not be pursued now.*

The people of the third world are in need. To personalize this plight, George Hoffman of TEAR foundation in London, England recently stated, "You must meet a person at the point of his need in order to meet his total need." Today, it might be food, water, or medicine; tomorrow, improved agricultural technology, sustained clean water supply, and public health education. Viewed from a Christian vantage point, however, the long-term solution must address the total person including the most basic need of spiritual renewal through restoration to fellowship with God through Christ. Scientists who are Christians are in a unique position to provide many improvements in the physical quality of life for Third World people as well as that extra insight and opportunity for individuals to become light and salt in their society. In keeping with "the use of science as servant" (one of the themes of the 1985 American Scientific Affiliation conference at

Oxford, England, which was co-sponsored by the Research Scientists Christian Fellowship), this paper will suggest a redirection of research and technology to meet the needs of people in the developing nations of the world. It should not be implied that other areas of research are necessarily unethical or even undesirable in principle. Rather, in the practice of good stewardship of our resources, some areas of research may be too expensive to be attempted at this point in world history. An example of this is the proposed superconducting super collider (SSC) of the United States which has a bottom line estimate of over three billion dollars.<sup>1</sup> In harmony with such Kingdom values as justice and

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concern for the poor rather than the secular values of material prosperity and affluence, this paper will review some specific and practical examples of the use of science and technology within the conceptual framework of appropriate technology in development.

Few Christians can argue from Biblical grounds that what the world needs is more bombs. Yet, more nations than ever before, at ever increasing intensity, continue to build and stockpile military weapons, with the result that in 1985 global military expenditures amounted to \$940 billion.<sup>2</sup> But, the Bible is clear that we are to care for God's world and be our brother's keeper (Gen. 1, 2). Should not the Christian who is a scientist make decisions about research in light of the Kingdom rather than national priorities? Should she/he not also influence the powers that be to channel more research and development funds to meet global human need? A pattern for reordering funding priorities using Christian principles in the area of energy resources has been set forth in *Earthkeeping*, a book edited by Loren Wilkinson.<sup>3</sup> In contrast with the present day high priority for research and development on fossil fuels and nuclear power, good stewardship suggests that we should concentrate efforts on solar and other forms of renewable energy.

Christian faith is centered in the Lord Jesus Christ revealed in Holy Scripture. By virtue of both Creation and Providence, Christ is not only related to all things (Col. 1:16), but He understands their interrelationships. In one sense, as Francis Schaeffer pointed out in a book about ecology and Christian faith, humans too are related to all things because of a common Creator.<sup>4</sup> Unfortunately, humans have not yet understood many of these interrelationships.

You no doubt remember the fundamental principle of ecology, "that everything is related to everything else." This is in harmony with the Christian belief that God is not only the one who set it up this way, but also that in Christ all things consist (Col. 1:17). The primary goal of many scientists who are Christians should be to

apply what we already know to the needs of society. Some may feel called to pure research, but, in making decisions as Christians, hard questions need to be asked based on Kingdom, not secular, values. God has not prevented humans from exploring the moon, sending space probes to distant planets, or discovering the latest sub-atomic particle. But each individual must wrestle with the emphases in Scripture on hunger and poverty and God's concern that justice roll down to improve the quality of life for every human on earth.<sup>5</sup>

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In setting priorities to fund research and develop technology, it is critical for the Christian to keep social justice in focus. As global human needs are accurately assessed, the commitment to do good to all men sets constraints on the pursuit of some categories of expensive research. One of the oft-quoted justifications given to the general public in the defense of multi-million dollar research projects is that applications of value are bound to follow in the next or succeeding generations. In the dim, terminal light of the nuclear winter scenario, this justification merits little support since few would survive to experience these applications. Recent articles by Harwell and Grover document the extent and severity of such a nuclear winter scenario.<sup>6</sup> The essential goal of this paper is to show how several ecological principles and their related technologies are applicable *now* to some of society's most pressing problems.

Early in the book of Genesis the message is clear that we are to care for God's earth. In recent years, Christians have responded positively to the challenge of



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Table 1  
*The Five Worlds\**

1st World	Most advanced industrialized nations: United States, Canada, Japan; Most non-communist nations of Europe, Australia, and New Zealand
2nd World	Communist nations: Soviet Union, China, and Eastern Europe
3rd World	States with one or more major resources that should allow them to become more developed nations without significant foreign aid: Oil-rich nations such as Saudi Arabia, Mexico, and Iran; Morocco (phosphate), Malaysia (tin, rubber, and timber); Zaire and Zambia (copper), Brazil, Algeria, and Libya
4th World	Nations with some raw materials that could eventually become more developed but only with a combination of aid from today's more developed nations and strong government programs for population control and increased self-reliance: Peru, Liberia, Jordan, Egypt, India, Nicaragua, Honduras, Ecuador, Sudan, Zimbabwe, and Pakistan
5th World	Ample human but few natural resources; without strict population control and massive foreign aid, these countries face mass starvation and continuing poverty: Chad, Ethiopia, Somalia, Rwanda, and Bangladesh

\*From *Living In The Environment* by G. Tyler Miller. See reference 15.

historian Lynn White (when he placed blame for environmental problems on the Judeo-Christian doorstep)<sup>7</sup> by publishing a number of books on the proper stewardship of God's creation.<sup>8</sup> Articles in this *Journal* have also addressed this theme recently.<sup>9</sup>

From quarks to biomes, the scientific search continues to expand and the knowledge gained brings power and the opportunity to exploit. The admonition of the writer of Proverbs, "With all thy knowledge seek understanding," is increasingly germane (Prov. 4:7). We should use the knowledge of science in the service of mankind. The applications of science need not continue to expand military technology into outer space in a competitive duel for control of the globe. Cooperative societies can also survive, as demonstrated by sociobiology's altruism as well as by several examples of insect/plant symbiosis from non-sentient nature.

The needs of mankind have been amply documented in a series of books referred to as the Club of Rome Reports, published from 1972 to 1982.<sup>10</sup> In addition, the Brandt Commission Report, the *Global 2000 Report to*

*the President*, the Worldwatch Institute's *State of the World* yearbooks, and the CHEMRAWN II conference proceedings have also attempted to chart pathways for solutions to global problems.<sup>11, 12, 13, 14</sup>

What are these needs of people in the developing nations? The best answer should rightly come from the spokesmen from those countries. However, I shall attempt to summarize these needs from my experience in Central America, from student interns that I have sponsored in Haiti, Honduras, Ecuador, Indonesia, and India, from experiences on a faculty committee selecting and supervising students in international internships, and from recent publications of others about developing nations. First, it is necessary to review the status and location of developing nations which can no longer be effectively considered in one block. G. Tyler Miller differentiates world nations into five categories as indicated in Table 1.<sup>15</sup>

Using this classification, it would seem best to concentrate research and development efforts on 4th and 5th world nations. This course of action differs from Garrett Hardin's triage and life-boat ethics approach

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**Table 2**  
*Problems of Developing Nations (and some solutions)*

1. Human Population Growth.....	(Population Stabilization)
2. World Famine and Acute Hunger.....	(International Aid)
3. Sanitation and Public Health Improvements .....	(Pure Water Supply)
4. Illiteracy .....	(Education)
5. Chronic Hunger .....	(Improved Agriculture)
6. Deforestation and Erosion of Topsoil.....	(Reforestation)
7. Depletion of Energy Resources.....	(Renewable Resources)
8. Too-Rapid Urbanization.....	(Improved Quality of Rural Life)
9. Traditional Values and Technology Conflicts.....	(Appropriate Technology)
10. Unemployment .....	(Increased Small Business Opportunities)
11. Nuclear Winter of Nuclear War.....	(World Peace)

which places a higher value on ultimate human survival as a species than on aiding each individual alive in the world today to survive. However, the Christian is morally obligated to aid every human being despite the cost to the resources of planet earth. This moral imperative implies that resources need to be judiciously managed to retain some useful measure of effectiveness.

Needs call for solutions. In Table 2 are some selected problems of developing nations that are particularly amenable to the applications of science and technology. To maintain hope, sanity, and a proper perspective, a partial solution is included in parentheses opposite each need or problem. This list is not all-inclusive, in order of priority, or particularly new or inspired. However, it focuses on critical areas of need to raise the awareness level and to suggest areas for involvement.

It should be emphasized that this list and the remainder of the paper do not attempt to explore the intricacies of the political, economic, social, and spiritual factors that also need resolution. No one item can be considered in isolation. Note that the first three and number five are closely interrelated and even number four is a means of progress towards alleviation of many of the other problems. Such connections do not surprise or discourage the ecologist who is mainly concerned with complex interrelations and interactions in nature. Four of the eleven problems are discussed below in some detail. Consideration of the remaining seven is reserved for a later paper.

### Human Population Growth

Human population growth, especially that of the developing nations, is thought by many to be one of the most critical areas of concern. Over five billion people populate the earth in 1987. In the Far East, India with 730 million and China with just over one billion account for almost 40% of the world's population. In

Table 3 some selected growth rates are compared to assess possible future trends. Recall that a 2% growth rate, which is the world average, results in a doubling of the world population in 35 years. (Average annual rate is now 1.63%.<sup>16</sup>) For the year 1985 presented here, growth rate measurably slowed in western developed nations such as England (0.1%), United States (0.7%), West Germany (-0.2%), and Sweden (0.0%). However, in Central America and Africa, many countries have growth rates above the world average: Guatemala (3.5%), Honduras (3.4%), Kenya (4.1%), Nigeria (3.1%), and Libya (3.5%).<sup>17</sup>

Reducing these growth rates is not a simple matter of advocating family planning and disbursing birth control devices. An educational approach includes increased efforts toward literacy. Cultural factors involve deep societal traditions of large families as a means of economic security. Preferences for male children increase the family size if the first few children are girls. Suggestions that we wait for the demographic transition to run its course are based on the questionable assumption that the cultural values and economic factors of 19th century Europe are sufficiently similar to those of present-day developing nations. Continued research in the area of human reproduction and birth control resulting in practical implementations for developing countries should have high priority. If present research efforts to enhance the success of Y chromosome bearing sperm are successful, should this type of sex control be promoted? Christians should be in the forefront of such efforts since other bioethical issues such as abortion are involved. Abortion as a method of population regulation can not be condoned. The People's Republic of China embarked on an intensive program to curb births by promoting one-child families, resulting in a 1.1% growth rate according to the 1985 Population Reference Bureau Chart.<sup>17</sup> Although government programs did not adopt coercive methods similar to the unsuccessful ones in

Table 3  
Human Population Growth Rates (1985)<sup>17</sup>

(World Average ..... 1.63%)	
Western Developed Nations	Central America and Africa
England ..... 0.1%	Guatemala ..... 3.5%
United States ..... 0.7%	Honduras ..... 3.4%
West Germany ..... (-0.2%)	Kenya ..... 4.1%
Sweden ..... 0.0%	Nigeria ..... 3.1%
	Libya ..... 3.5%

India in the 1980's, the strong tax incentives, limiting of educational and food supports to one child families, and other pressures resulted in increased abortions.<sup>15</sup>

Are we ready to concede that humans have fulfilled the Genesis command (Genesis 1:28) to replenish or fill the earth and do our part to achieve population stabilization? The interpretation of this command in our day has a different context than when it was first given to Adam. It involves not only numbers of people but also the concept of carrying capacity. How many people can the earth support at a moderate standard of living without jeopardizing its resource base? Some ecologists would claim that the present five billion inhabitants are already beyond the sustainable society level. If the United States standard of living was the norm for the world, then many more would readily agree that we

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have passed the optimum limit. The exact number may never be known or accurately predicted from modeling projections, but the existence of finite resources and the necessity to live within the boundaries of energy and other resources has been firmly established as a valid ecological principle.

#### Sanitation and Public Health Improvements

On a recent summer internship in Africa, one of our biology students made a public health survey of seven

villages for the mission that sponsored his overseas experience. The two villages that had wells for their water supply had 50% less infant mortality than the other five villages using surface water supplies. Over 125 years have passed since the scientific discoveries of Pasteur, Koch, and Jenner documented the role of bacteria in disease and the prevention of infection with sanitary practices and vaccination. Almost sixty years have elapsed since Fleming's discovery of penicillin in England. Today, however, large segments of the human population in Central and South America, Africa, and the far eastern countries of India, Bangladesh, and Indonesia have yet to experience the benefits of these far reaching discoveries for the benefit of human health. William Cobern, one of the ASA global resources and environment commission members with four years experience in Sokoto, Nigeria, wrote to me recently that clean water and a sanitary sewer system in this city would do much more to improve health than their present hospital, which was not much cleaner than the outside streets. He indicated that hospital workers and even nurses simply do not believe in the germ theory of disease. Malaria, schistosomiasis, river blindness, and ascaris infections take their annual toll in mortality and sub-normal health existence.

In the setting of priorities for health care, should we not attempt to provide equal treatment for all of God's humanity the world over? Can we continue to spend several hundred thousand dollars for the surgical correction of one heart condition to extend the life of the already elderly when the life expectancy of many in the world is still below fifty? Would not the better choice be the expenditure of these funds for the continuation of promising research on the development of vaccines for parasitic diseases through immunogenetic techniques? Millions of dollars in research are channeled to find a cure or better treatment for cancer which, with certain exceptions such as leukemia, is largely a disease of the aged. The method for the reallocation of financial resources is beyond the scope of this paper, but for developing countries, the total cost of digging wells, constructing latrines, and immunizing

young children against just two or three major infectious diseases would make only an insignificant dent in the multi-million dollar research budget of just one agency, such as the National Institute of Health in the United States.

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### Chronic Hunger

Several areas of the world are now experiencing severe famine and crop failures with thousands dying of starvation and many more subject to disease and malnutrition because of inadequate diets. Ethiopia and several other independent nations of West Africa in the Sahara and Sahel regions are among those severely affected. Along with massive aid efforts from many nations has come an increased awareness that long-term solutions for chronic hunger through comprehensive development programs sensitive to local cultures must be cooperatively put in place to mitigate the suffering from future cyclic incidents. It is unfortunate that funding priorities often delay the needed development programs. Ethiopia, for example, now expends forty-two percent of its budget for military purposes.<sup>18</sup> A recent book edited by Earl Scott entitled *Life before the Drought* reviews the history and practical knowledge of the indigenous peoples of the Savanna-Sahel zones. With considerable ecological insight, Scott reveals the close cooperative arrangements worked out by the Fulbe (Fulani) nomadic and Habe (Hausa) sedentary groups of northern Nigeria. Contrary to other competing and warlike conflicts of many nations, these two groups started with casual contacts and are evolving toward a mutualistic relation that under certain situations can be perceived as one ethnic group.<sup>19</sup> Many examples exist where foreign intervention, food aid, and development projects have harmed more than helped, but it is Scott's opinion that modern technology can fuse with local customs and cultures if sufficient efforts are made to incorporate the creative insights of the indigenous population. Although the Green Revolution was helpful in some locations, the dependency created for increased fertilizer, specialized genetic seed stocks, and the costs to sustain this introduced agricul-

ture indicate that it is not the best solution for most developing countries. A particular case of disastrous intervention in Northern Nigeria was reviewed by Scott to indicate that we must be more sensitive to local cultural and environmental conditions if our desire is to be part of the solution instead of adding to the problem. Critics of the recovery projects promoted by the United States Agency for International Development, in collaboration with a local Senegal organization, point out that forcing the production of rice for the urban market requires expensive inputs and increases health hazards from malaria and schistosomiasis. In this instance, the production of the local staples, millet and sorghum, using inexpensive tools and organic fertilizer available locally would have led to maintaining stable food production and been less destructive to the environment. In an article, "The Third World in the Global Future," Peter Raven in the November, 1984 issue of *The Bulletin of Atomic Scientists* states, "For tropical countries, only sustainable local agricultural productivity—not food exports—will lead to stability." Carrying this one step further, ASA member Martin Price of the ECHO organization has suggested that we need to replace the concept of subsistence farming, which sounds rather dull and drab, with attractive alternatives and incentives so that there will be a flight from the city to the rural areas instead of the present trends in the Third World toward urban shanty-towns. As many of you know, Martin has combined action with his suggestions and is involved in developing fruits, vegetables, and other grains that are native to the regions where they will be used. Although small in scale, this effort, which utilizes missionary contacts and student interns, is a model worthy of expansion and implementation in other locations.

### Traditional Values and Development Technology Conflicts

In the June, 1985 issue of the *Journal of the American Scientific Affiliation*, Ramon and Bube include several cautions and constraints that are relevant to the involvement of helping those in developing countries. They state, for example, that "an integrated development must be adapted to the needs and possibilities peculiar to the local region of the specific country where the development is to take place."<sup>20</sup> Since Schumacher's *Small is Beautiful*, the concept of appropriate technology has had a steady growth in acceptance and expansion in use as lessons from experience have improved the interactions and reduced the problems of implementation.<sup>21</sup> One of the most active groups in bringing together the sources of information is known as Volunteers in Asia, a group of young people associated with two universities in California. Details about their three volume publication entitled *Appropriate*

*Technology Sourcebook* are included in the list of references for this paper.<sup>22</sup>

In many parts of Africa the woman with the hoe represents the state of technology. Even the wheel and cart are not part of the rural economy. As recently as two years ago in a large valley of interior Honduras, I saw an irrigation system that was introduced for the first time using a water wheel similar to those used in China many centuries ago. At this particular site a Christian missionary who has spent seventeen years in evangelistic and educational work has just begun to broaden his efforts to include irrigation projects and small business ventures in woodworking and metal trades. The confidence established in this long predevelopmental period has resulted in enthusiastic acceptance of these forms of appropriate technology.

The need of the hour in this geographic area, and I suspect in many others, is not the technological breakthroughs of genetically engineered plants requiring continued dependence on developed countries for fertilizers, seeds, and technical expertise, but appropriate technology adapted to local situations. An excellent illustration of this latter approach is the successful project at the University of Nairobi in Kenya, Africa. A microbiological resource center there, similar to others throughout the world, has developed various strains of the nitrogen-fixing *Rhizobium* bacteria and has deter-

mined the parameters affecting the survival of rhizobia in soil. Since 1975, more than 10,000 farmers have used these cultures to improve production on their farms.<sup>23</sup>

Technology transfer is thus not a simple one-way transaction. In the area of public health, for example, one of my student interns, with the aid of a native Honduran trained medical doctor, compiled a useful study in Spanish on traditional medicine. In many cases modern treatment can be integrated with long standing, traditional customs, and the doctor-patient relationship is enhanced as well as physical health improved.

Future progress in meeting the needs of our human neighbors world-wide will be facilitated if we encourage one another in the Christian faith to influence science for the benefit of society. Let us resolve to support those areas of scientific research and application that hold promise of not only meeting the food and health needs of developing nations, but are also consistent with the principles of Scripture that teach the careful management of our ecosystem resources and a prudent use of monetary sources. In the closing chapter of the 1986 *State of the World* book, Lester Brown states, "expenditures on weapons research, in which a half-million scientists are now employed, exceed the combined spending on developing new energy technologies, improving human health, raising agricultural productivity, and controlling pollution."<sup>24</sup>

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