and referred to the Committee on the Judiciary, as follows:

S. 1233. A bill for the relief of Mrs. Gretel Rieger Micol; and

S. 1234. A bill for the relief of Max Ratibor.

ORDER OF BUSINESS

Mr. BYRD of West Virginia. Mr. President, I ask unanimous consent to be permitted to proceed for 15 minutes.

The PRESIDING OFFICER. Without objection, it is so ordered.

Mr. COOPER. Mr. President, will the Senator yield briefly?

Mr. BYRD of West Virginia. I am happy to yield to the Senator from Kentucky.

COAL MINE HEALTH AND SAFETY

Mr. BYRD of West Virginia. Mr. President, the tragic coal mine explosion that occurred last November near Farmington, W. Va., has made it certain that this session of the Congress will consider several new proposals for coal mine health and safety legislation. The scale of the Farmington disaster, which claimed the lives of 78 miners, inevitably has raised many questions concerning the adequacy of the present Federal Coal Mine Safety Act.

I am certain that all of us here in the Senate will want to consider carefully any reasonable proposal for more effective health and safety laws. Hearings on the legislative proposals now being submitted will enable us to reach objective conclusions concerning any changes that should be made in the existing act.

My purpose today, however, is to urge all of my fellow Senators to consider every possible way in which our coal mines can be made safer and more healthful for the men who work in them. New and stronger laws, however necessary and effective they may be, provide us only with a means of coping with hazards. I contend that the time has come for us to do more than cope with menaces that can wipe out 78 lives in a single, horrible accident. We can, and must, eliminate these hazards.

The former Secretary of the Interior, Stewart Udall, a forceful advocate of stronger law in this critical area of industrial health and safety, recognized the limitations that are inherent in law. He made that clear at his December Conference on Coal Mine Safety, when he said:

> Even in a coal mine that is a model of compliance with the most rigorous safety regulations that can now be devised, the elements of danger will be present.

The adoption of additional mandatory safety standards may help to curb the threats posed by these elements of danger but will never completely eliminate them. No law can make methane and coal dust less explosive; and no law can remove them from the places where coal is minded. The most stringent laws, however rigorously they may be enforced, cannot assure stability of the rock formations that typically overlie a coal seam. And laws will never protect men fully against the hazards that exist when huge, powerful machines are operated in the confines of an underground mine.

Nevertheless, these hazards can be minimized. How? By developing a better and safer technology for mining coal—a techonology that retains the good features of equipment and methods now in use, and even improves on them. But a technology that also brings health and safety provisions into better balance with productive capability.

The Congress traditionally has sought to promote the development of improved mining technology. In fact, the congressional role in promoting such improvement antedates by three decades the passage of the first coal mine safety legislation. In establishing the Bureau of Mines in 1910, the Congress directed that agency explicity "to make diligent investigation of the methods of mining, especially in relation to the safety of miners." It is time that we renewed this mandate. We must provide the resources that are needed to develop a coal mining technology that is intrinsically safe and healthful.

What is wrong with the coal mining technology we have today? In some respects it is the world's most modern—a result of the intensive mechanization process through which the industry passed after World War II. Spectacular brakthroughs were achieved in coal cutting techniques—breakthroughs that have made the American coal miner by far the most productive mine worker in the world.

These advances, however, did not incorporate methods for dealing with mine hazards, which are intimately related to mining methods. Centuries of exposure to these hazards have obscured this relationship. As a result, coal mining technology has advanced, but in a lopsided way, and 20th-century mines sometimes use 19th-century safety procedures. American coal miners are the world's most productive, but they work in one of the Nation's most dangerous industries.

The hazards of coal mining are linked so closely to the methods used for recovering this fuel that development of proper mining techniques can make the Nation's coal mines significantly safer. But, first we must rid ourselves of the notion that safety and health are "optional extras."

Our energies have been misdirected in trying to cope with hazards that need not have arisen. It is all too apparent that we have failed to keep pace with the dangers of mining, and as a result coal miners are dying today from many of the same causes that killed their fathers, grandfathers, and great-grandfathers many years ago.

The ultimate and lasting solution to this problem lies in the development of a coal mining technology that is intrinsically safe—a technology that has provisions for the health and safety of coal miners built in, rather than added on.

There may well be some astonishment at this proposal. The idea that "coal mines are inherently dangerous" has been repeated often following and prior to the Farmington disaster. Yet, I am convinced that we mine coal in ways that are often needlessly dangerous, and that coal mine hazards can be traced in large part directly to the methods by which coal is mined.

For example, consider the continuous mining machine. This impressive device may be up to 38 feet long, and capable of tearing coal from a solid seam at rates in excess of 8 tons a minute. Its efficiency is in no small measure responsible for the remarkable productivity of the American miner, and many view it as an outstanding example of advanced technology. As it has increased productivity, however, the continuous mining machine has also aggravated some of the most serious health and safety problems known to coal mining.

Because it cuts through coal so rapidly, this machine makes possible the liberation of methane gas at a high rate, thereby increasing the danger of explosions. Because it breaks the coal into such fine particles, it creates more dust, generating an added explosion hazard as well as a threat to the miners' health. Finally, its speed of advance can outstrip the adequacy of methods presently used to support the roof it exposes and to haul the coal that it mines.

Our traditional response to such problems has been to accept them as inevitable, adding safety options to control the hazards whenever possible. Experience has shown us that this approach just does not work. In fact, it has even introduced new hazards while in the very process of minimizing old ones. For instance, the accepted way of coping with the explosive methane liberated by continuous mining machines is to dilute it and remove it from the mine with a rapidly moving current of ventilating air. But the moving air current stirs up and distributes coal dust, actually intensifying the dust-related hazards of explosion and lung disease, such as black lung.

This is no isolated example of a self-defeating cycle. Many of the techniques now used in coal mines are equally dangerous, and cannot in any realistic sense be called modern. Coal mining technology, like so many other technologies in America today, has advanced rapidly on some fronts while falling behind on others. Throughout American industry the growth of technology has, with few exceptions, been characterized by spasmodic and uncontrolled progress toward the goals to which technology is supposed to carry us.

In many cases the resulting side effects have assumed greater significance than the original purpose. Environmental pollution, for example, is an industrial side effect which is becoming almost as noxious as the products of industry are desirable. The ultimate cause of pollution is the failure of technology to provide waste-disposal methods that are as effective as production methods. Similarly, today's coal mining technology fails to guarantee the safety of miners almost as effectively as it guarantees the Nation a supply of low-cost energy.

Why this imbalance in technology? Why has progress in some areas caused unexpected problems in others? Perhaps because many persons believe that tech-

nology advances through some mysterious evolutionary process that cannot be controlled or predicted. As a result, technology is allowed to create unforeseen problems, like the dust hazard associated with continuous coal mining machines, and the more widely experienced air pollution problems of our big cities.

The advance of technology can be directed, however. It is necessary only to identify the goals of technology clearly, and to think through implications of the methods chosen to reach these goals. In engineering language this is called "the systems approach." Systems engineering methods have arisen as a response to the chaotic growth of today's technology, and they are designed, in part, to eliminate the undesirable side effects that have accompanied such growth.

Systems engineering was first applied in fields where technological complexity was extreme, such as weapons research and development and space exploration. Using the systems approach, space engineers have gone far toward guaranteeing that their complicated rockets and space capsules will function smoothly. The flight of Apollo 8 around the moon is clear testimony to the advantages of systems engineering. Is it not time that we begin applying it to the age-old process of coal mining?

The Interior Department's Bureau of Mines has, in fact, been carrying out a modest mine systems research program for several years. The basic concept underlying the Bureau's work is that mineral recovery is not a series of separate and unrelated operations, but a single integrated system, of which extracting the mineral, moving it to the surface, and controlling the mining environment are interrelated and interdependent parts. The Bureau's ultimate goal is a kind of master formula which, when applied to a given mineral deposit, would enable an operator to balance alternative combinations of subsystems against one another and come up with the safest and most healthful, and at the same time the most efficient, mining method for that deposit.

Applied to coal mining, such an approach can yield many tangible advantages over the methods used today. For example, before mining even began, the operator would determine how gassy his coal deposit was, and then choose mining equipment and techniques that would minimize the explosion hazard. He would also choose equipment and techniques best suited to the geology of the formations surrounding the coal seam. Thus, from the beginning, safety and health would be considerations equally as important as production.

In the long run, of course, the whole nature of coal mining as we know it today may well be drastically changed. But that change, in a systems-oriented industry, can be planned and carried out in a way that makes sense from both the humanitarian and the economic point of view.

The systems approach can also benefit mines in which operations already are well established. An immediate objective should be to devise techniques of roof support, haulage, ventilation, and other mining procedures that are either wholly compatible with the methods and equipment now used, or would require at most only minor modifications of such methods and equipment. The essential difference is in the approach to the problem. Coal mining must be looked at as a system of interrelated and interdependent functions, rather than a series of separate and unrelated operations. Consequently, if we have a machine that can mine coal at the rate of 8 tons or more per minute, we must consider the implications this machine holds for all the related parts of the mining cycle. We must, for example, find ways to move the broken coal, and the coal dust generated by the machine, more rapidly away from the face of the seam. And we must also develop roof-support subsystems that are more compatible with a rapidly advancing mechanized miner.

By concentrating on this kind of approach, I'm convinced that we can make coal mining, at an existing mine as well as at new mines, far safer and much more healthful, and at the same time increase even more dramatically the productivity of the American coal miner.

A great deal of research and development will be needed, however, before we will be able to mine coal with such truly modern methods. Application of the systems approach requires, among other things, a fund of basic knowledge about the geology and physics of coal and coal-bearing formations—knowledge that is lacking today. It requires the availability of alternate mining methods, more flexible than today's, so that the goal of high productivity can be met without undue reliance on a single type of equipment which, like the continuous mining machine, may have as many drawbacks as advantages in some deposits. The Bureau of Mines is convinced that such requirements can be met—but only with an expanded research effort. I strongly support the allocation of more research funds to the Bureau to pursue this important work.

Highest on the Bureau's list of priorities is research on applying the systems approach to the methane gas hazard. The Bureau contends that several alternate ways of dealing with methane must be developed, to permit maximum flexibility and to free operators from their dependence on ventilation as the sole means of coping with the danger of explosions. For example, draining the coal seams of methane in advance of mining might prove the best method for some of our highly gassy mines. Or the rate at which methane is liberated from a coal seam might be reduced by controlling the pressures exerted by surrounding rock formations—a possibility indicated by the results of recent Bureau research. Another possibility would be the development of ways for making methane chemically inert as it emerges from a coal seam, before it has a chance to explode. Any one of these approaches it should be noted, would be compatible with the methods and equipment now in use.

The Farmington disaster has told us in terms of stark tragedy that research toward goals like these can no longer be deferred. The Bureau should be given adequate funds, not only to conduct research in its own facilities, but also to award research grants and contracts to schools of mining engineering and similar institutions where pools of knowledge and professional talent lie waiting to be enlisted in this urgent enterprise. The Bureau's staff is too small, and the problem too large, to ignore the contributions that can be made by the many excellent academic and research institutions already operating in this field. I have heretofore supported increased funds for coal research, and shall continue to do so.

The coal mining industry can also make a major contribution to the effort. It can send its most creative and skillful engineers to work in Bureau laboratories on a cooperative basis, and it can make its mines available for research and testing that will have to be done in the field. In this way, development of new coal mining systems would become a joint industry-Government venture, and many of the results could be put into practice by industry almost as quickly as they emerged. The Bureau's understaffed corps of scientists and engineers would be supplemented by talented industry personnel who, returning to their companies, would be qualified and ready to adapt systems technology to individual mines without delay.

If these steps are taken, we can look forward to the emergence of modern coal mining systems that can ultimately reduce our reliance on legislation as a cure for ills that will one day cease to exist. Such systems will not, of course, come into being quickly. Several years of concentrated effort will be needed, for we have delayed too long already. But no field of technology has as much to gain from the systems approach as does coal mining with all its hazards.

The highly successful application of systems engineering to the space program has begun to encourage its use in other fields. For instance, the complicated modern problems of data processing are handled by systems, of which the electronic computer is but one of many subsystems. Authorities now are advocating the application of systems engineering to solve the Nation's staggering waste disposal and environmental problems, which are, like the hazards of coal mining, largely the products of a literally unsystematic, highly sophisticated technology.

If we can afford systems that send men to the Moon, or process inconceivable volumes of data with superhuman competence, surely we can afford and develop systems that will conserve our most valuable resource—skilled manpower. The cost would be relatively low; especially when we remember that two-thirds of America's energy is supplied by coal, and that coal mining is America's most dangerous major industry. In the current uproar over coal mine safety, there can be no disagreement on the desirability of the systems approach as a solution. Only our willingness to make possible the application of this modern concept remains in question.