Our Exhaustible Resources of Minerals—What Should Be the Aims of a Conservation Program?

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SCIENTISTS, as a professional group, have emphasized the importance of conservation of our natural resources along ethical lines more than any other group of our people. And there are reasons why they should. They do not believe in wasteful exploitation; they appreciate the place which natural resources play in the role of progressive human society; they are as devoid of ulterior motives and selfishness as any group; they possess a larger knowledge of the limitations of the natural resources with respect to requirements of future generations than most lay groups; and they have become liberated from the old view that the life of man on this earth is likely to be cut short at an early date. Furthermore, they have a passion for progress and a realization of the rights of unborn generations.

With respect to conservation, astronomy teaches limitless time, physics the relatively unlimited sources of solar energy, chemistry the universality of the physical and chemical changes, geology the long future of habitability of our globe, and biology the probable and relatively endless chain of generations of the human species, at least so far as a long future is concerned. All of these sciences furthermore teach that we of the present are writing a tremendous draft upon the resources which future society will also require.

On the other hand, the average layman and the average business man deals primarily with the realities of the present generation. A future of a few centuries is a tremendously long time to him, a million years is hardly a reality to him, he still thinks in terms of the possibility or probability of vast resources yet to be discovered, he is quite naturally concerned with the problems of operating at a profit in the exploitation of the natural resources rather than with the problems of existence which will face generations of mankind in the remote future, and he faces daily the changing forces of competition which continually threaten to put him out of the running.

It is therefore not surprising that there should be these differences in points of view between the scientists and the laymen.

Yet, notwithstanding these different points of view there has developed a wide and increased interest in the subject of conservation and a greater recognition of its importance. However, we must realize that the *modus operandi* by which progress in conservation may be accomplished is and must be inevitably slow, by reason of the imperfection of our knowledge as to how best to use our natural resources. This fact places a heavy responsibility upon all of the sciences, because their contribution must be something more than the mere teaching that conservation is a necessity.

Historically the conservation movement in America had its inception in the rapid depletion of the forests and in the consideration of certain factors which must be taken into account in the development of our streams. The disappearance of the forests could be seen by everyone, and the problem of the changing regimen of our streams, brought about by the widespread destruction of the natural vegetal covering and the plowing of the soil, was apparent to engineers and statesmen who had given the matter study. As the industrial revolution got under way, following the Civil War, and increasing quantities of iron ore, coal, copper and other minerals were extracted, it became more and more apparent that vast inroads would soon be made on the exhaustible resources of the nation. It, therefore, came to be realized that this country was facing a grave national problem. This led President Theodore Roosevelt to call a conference of the Governors of the forty-eight states in 1908.

Although the motives for the call were most worthy, the results were not entirely satisfactory. Anyone who reads the minutes of that conference and the addresses that were made cannot help but feel that too much stress was laid on the wastefulness and the exploitation methods of private industry and too little recognition given the conditions which, to a certain degree, justified the methods at that time in this country's development.

This was in part remedied rather late in the conference, in an address made by our revered former President of the University of Illinois, Dr. Edmund J. James, at the fourth session. His point of view is worthy of our careful consideration, and I therefore quote extracts at some length.

> There is no doubt that we have been extremely wasteful in our mining processes, taken as a whole, and it is high time we should direct public attention to the necessity of greater efficiency in our methods of mining than has characterized our operations thus far. But after all, the determination of what is the proper mining policy turns essentially upon economic considerations. Economic exploitation of our mining resources does not consist in making the utmost possible saving in the narrow sense of the term. It would, for instance, be perhaps entirely feasible in the mining of coal or iron to extract 90% or 95% of the coal or iron from the mines which are open, and yet such a policy might be after all uneconomic. In other words, it would probably cost more than the entire coal is worth to extract from the mines 99% of the coal to be found in them. It would probably cost quite as much as the gold and silver and iron are worth to undertake to extract 99% of the metals to be found in the mines. That is to say, the extraction of all the valuable material would be such an expensive proceeding as to make mining itself unprofitable. This, of course, would be uneconomic in the highest degree. The question, therefore, as to what the best mining policy is must turn at bottom upon the fundamental question as to what method will, everything considered, turn out the highest possible value.
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> It would be quite feasible, therefore, though I should think there is very little probability of such a state of things, to adopt a set of mining laws which would hamper the development of the mining industry to an entirely unreasonable extent, as I am quite sure some of the mining codes of other countries have done.
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> There is no doubt that we have exploited our farms and our lands in many parts of the country in a very wasteful way; that we have exploited our soils in some cases to such an extent as almost to destroy them and to make it impossible to restore them except by a very large expenditure, if at all. . . .
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> But economics students would insist that the fact that certain farms in the United States have passed out of cultivation does not of itself prove that the agriculture policy of the Nation has in the large been a mistaken one. . . . Many farms in New England and New York and some parts of Pennsylvania and Virginia have in the last two generations fallen out of cultivation. This fact in itself does not necessarily prove that the agricultural policy of the State or Nation has been bad. On the contrary the fact that those unproductive farms fell out of cultivation was in many instances a sign of one of the greatest blessings that ever came to the American people, namely, the possession and opening up of magnificent opportunities in the Mississippi valley and the West. . . . Those farms fell out of cultivation not because they were exhausted, for in many instances they produced more than when they were first cultivated, nor because we can not cultivate them today as well as we could cultivate them when they were first put under the plow, if we were only willing to accept the return which they would bring us; but because the standard of life among the American people has advanced to a point where the methods of the cultivation of the 1850's applied to those farms will not yield us that with which we are or should be content.

Thus, it should be emphasized that the economics of the situation must be given a fundamental place in considering any program to accomplish conservation.

Conservation of Minerals

We are concerned in this paper with the question of the conservation of exhaustible mineral resources, primarily those of Illinois.

In this State, as in most states, the mineral resources belong to individuals or companies or corporations. The theory of our constitution and of our laws, we infer, is that they, like the farm lands, are for private use or exchange. If they occur under conditions such that they enhance materially the value of the land, they are taxed along with the land. Legislation affecting their recovery concerns primarily human safety and to a small degree their preservation from damage, as in the case of oil-well drilling through coal beds.

The amount of capital invested in their recovery, preparation for the market and for means of distribution by railway and motor truck, represents hundreds of millions of dollars. Industries have arisen which provide employment for many thousands of men. Communities have been built up around them. The ability of the companies to fill contracts for large orders has brought other industries to the State. In these and other ways, the mineral industries of Illinois have become indispensably an important part of the framework of society.

What is the status of their conservation?

In a paper of this scope it is not possible to review all of the mineral resources of Illinois with respect to the status of their conservation; we shall be limited to one of them, and only the broader features of that one, and from it develop our thought as to what a conservation program should entail.

We shall consider coal, that mineral being our most valuable mineral resource. In shaft mining, in the Northern Illinois field, the Longwall system is used and about 95 per cent of the coal is recovered, whereas in the rest of the State the room-and-pillar system is used and the average is about 50 per cent. By far the larger percentage of coal mined in the State is by the room-and-pillar system. The reason why the room-and-pillar system is used, although the percentage of recovery is only one-half, are in the last analysis purely economic. Where the coal beds are thick and other conditions are such that "back filling" cannot be employed to prevent subsidence that will alter the surface drainage of level agricultural lands or damage surface structures, pillars of coal of adequate size must be left. Damage to farm lands is a controlling factor in Illinois. Unequal subsidence may create swampy places or disturb drainage systems or damage water wells. This invites damage suits asking for extravagant awards. This, and other uncertainties, deter attempts at pillar recovery. Outright purchase of both surface and underground rights prevents insuperable obstacles in many cases, but where this is done there are usually other tracts intercheckered with these so that no relief can be obtained. Moderately hilly areas offer their problems also if the subsidence cannot be controlled to keep from interfering with streams and surface structures.

Coal losses, however, include other than that left in pillars. In places coal is left in the roof and on the bottom, especially if it is very high in ash or if needed to serve special purposes. Coal must also be left under railroads, along boundaries, or to prevent flooding from water in abandoned workings at a higher elevation. Much coal is also lost through premature abandonment of mines. In many cases such pieces of virgin coal are so irregular and small as to make the cost of future reopening prohibitive. Such premature abandonment took place on a considerable scale during the 20's and early 30's of this century when depression conditions caused many companies to become bankrupt. Coal is also lost where there are rolls or where the coal bed becomes too dirty or too thin to work under present economic conditions.

From the foregoing and other facts it is apparent that the problem of conservation is exceedingly complex. These complexities become even greater when it is realized that competitive conditions are such that small additional

costs would endanger or effect bankruptcy, and as has just been pointed out, bankruptcy in many instances brings waste from premature abandonment of irregular areas of virgin coal, and it also has its serious effects upon employment and general economic conditions.

Since about 1920 the market for coal has ceased to grow, generally speaking, due to competition of other fuels and energy resources.

Strip mining results in recoveries closely approximating 100 per cent, but in this case the soil resources are destroyed. This raises the question of competition in conservation, another angle of the already complicated problem. Strip mining also sacrifices employment opportunities because of its highly developed state of mechanization. Thus there are arguments on both sides, but again we are reminded that the task of outlining or shaping a program of conservation is not as easy as the great majority of our people might think.

Losses which are unavoidable must be charged against the conditions under which we are operating. These conditions are either economic or technological. While advances in technology have been rapid, relatively speaking, we have a long way yet to go before we shall have the scientific and technologic information necessary for an adequate conservation program. Many of the so-called wasteful practices in the production of coal, as in the production of many other commodities, have been necessary for the industrial development of the State, and for the progress in the standards of living which we all share. We cannot afford, therefore, to be radical in the changes that we wish to bring about for there is danger of disaster for both the financial and social well-being of the entire State.

It is also well, before we embarrass ourselves with making unjust criticisms, to recognize that incomplete recovery is less sinful than wasteful utilization. After the coal is delivered to us for our use, how many of us use it efficiently? We burn only a portion of it and send the rest up the chimney. We conserve only a part of the heat and let the rest pass through our uninsulated walls and ill-constructed windows and doors. In the power industry, in the use of railroad fuel, and in blast furnaces, we have advanced, but much remains to be done.

Again, we shall be criticised for such waste by future generations, unless they liberally charge it against the incomplete state of our knowledge.

Where then, and how, shall we attack this problem of conservation of our coal resources?

Let us be exceedingly cautious about legislating ourselves into a solution, except where it is patent that legislation has a place. Instead let there be an insistence on improvement in our technical knowledge by thorough-going researches and practical demonstrations of the findings. First of all it is necessary to pursue investigations in regard to the geological conditions that must be met in economic mining; second, there must be further experimental study in the technology of mining; third, there must be a thorough study of the constitution of the coal-beds in order that progressive steps can be taken in the proper preparation of the fuels for their different uses; fourth, researches must be carried on to perfect the use of coal; and fifth, studies must be made of the economic conditions of the markets, in order that abnormal situations may be recognized; and sixth, the ready dissemination of new knowledge should be facilitated.

The policy of increasing our knowledge will lay the proper foundations for policies of conservation, and will react beneficially to sound economic and social conditions. The same principle is fundamental with respect to our other exhaustible natural resources, the discussion of which is impracticable here within the limits of time available.

Increase in knowledge will be an important compensating factor to award to our descendants for the depletion of natural resources which they will inherit. As two of our authorities on the economics of mineral resources have stated: " . . . if science shall make a revolutionary discovery, if man shall unlock the secrets of photosynthesis and atomic energy, our population may then be trusted to increase to the point at which it can make full use of the new stores of power."[1]

[1] F. G. Tryon and Lida Mann, Mineral Resources for Future Populations, Pollak Foundation for Economic Research, Newton 58, Massachusetts.