

Commentary

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My discussion of Theodore M. Schad's paper is going to be amicable. I have no quarrel with the facts on which he bases his arguments and I agree with his conclusions, although I may be a bit more pessimistic than he is about the future at least until we make some difficult decisions. I think the most useful contribution I can make to our deliberations here is to tell you how some of the points made by Mr. Schad appear to a Canadian, which may indicate that we put a different emphasis on some of them.

I must admit that having worked with Americans nearly all my professional life in cooperation on river systems (such as the Niagara, St. Lawrence, and Columbia) and then having served with the International Joint Commission for several years, I occasionally suffer a lapse into confusion about what I mean by "we" and "you." Sometimes "you" are Americans and "we" are Canadians, but often "we" are engineers and scientists, and "you" are those who disagree with "us."

May I make it clear that I speak in my private capacity as a professional engineer, and that while I am not aware that Canadian government has a different point of view or policy than I will be expressing, still I am not pretending to be giving you an official Canadian viewpoint.

First of all I would like to emphasize a point about water use that occasionally is forgotten. Sometimes accidentally and sometimes deliberately, confusion arises about the nature of consumptive use of water, which we speak of as the "bottom line" in water demand. Consumptive use is overwhelmingly for irrigation. Irrigation use is at least a full order of magnitude larger than other consumptive uses. For instance, the use by

all the people of California, for domestic and industrial purposes, would only be about 15 percent of the consumptive use in the state. That is the withdrawal, mind you, and usually two-thirds of municipal withdrawals are returned to the water cycle at a point not far removed from the point of withdrawal. Municipal consumptive use therefore amounts to something in the order of 5 percent of the total. Other consumptive uses are also normally small so that when we talk about water supplies and water shortages and water demands, we are in the main talking about water for irrigation. This point needs to be kept in mind.

Of course there are specific concentrations of other consumptive uses that may raise some local difficulties. These usually occur in large cities where industries and municipalities use large quantities of water. However, conservation practices are very effective in reducing consumption, generally through on-site treatment and reuse in industry, and through pricing in municipalities. The important point to remember is that the shortages we face are basically for irrigation.

Mr. Schad's review of various possibilities for augmentation of the supply clearly makes the point that while we may tinker with the established system, there is little hope of significant results in the next couple of decades. One can go further and say that even after that period there is little ground for hope that anything significant will occur until we can make a quantum leap in energy supplies to a point where pumping and desalination can be undertaken on scales not presently viable. In addition, we will have to achieve a better understanding of environmental impacts and methods of protection.

The greatest changes we have brought about in water supplies are by means of dams and canals. The impoundments behind dams transfer water in time, from one part of a year to another, or even to another year. Canals (and tunnels and pipelines) transfer water in space, from one part of a valley to another or even to another valley or another basin. These two mechanisms are combined to make water available to dry areas at times of need. However, I believe we have passed the heyday of dam-building and interbasin transfer. Recreation and environmental concerns have created a whole new concept of what has to be considered in deciding on whether or not to carry out such projects.

I do not think we should decry what we have done in the past. Those projects which I am familiar with such as the Niagara developments and the St. Lawrence, the Ottawa River, the Peace, and the Columbia (in Canada) have to my mind had benefits far outweighing the costs. But the most beneficial and least harmful projects have naturally been done first, and the costs of those left tend to be high. This becomes more apparent when we begin to recognize and count certain types of costs that have been ignored in the past, such as loss of recreational opportunity or aesthetic values.

Mr. Schad says quite rightly that interbasin transfers across state lines are dubious today. We now recognize that the selling of our water birthright is a very doubtful transaction under the best of circumstances. It is difficult to assess what new uses and priorities will arise in the future. This is important because I believe that such a sale has to be considered as being in perpetuity. It is well nigh unthinkable to cut off a supply on which an agricultural industry and a significant social complex has developed. I am not suggesting that no more interbasin transfer schemes will be carried out, but I do suggest that the colossal concepts such as NAWAPA will not be practicable with the technical, economic, energy, and political constraints under which we presently live, and even smaller schemes are going to present great difficulties.

To a Canadian it seems as if the most logical source of water for the western United States is the Columbia. In that river we generously allow an annual average of some 90,000 cfs (nearly 60 bgd) to flow unimpeded across the forty-ninth parallel for your use. In fact, we have even allowed you to build, or at least pay for, three very large dams in Canada that markedly improve the flow distribution throughout the year—to our mutual advantage. We have our own critics who claim that under the Columbia Treaty, we have sold our birthright. This I do not believe. I am satisfied that the Columbia River development in Canada has been to our advantage and we will long enjoy substantial benefits from it. But these developments and the many more in the United States make the Columbia a very large water resource within your own jurisdiction.

I recognize that the economics of moving this water to areas

of shortage are doubtful, but they must be just as doubtful for our Fraser River, if not more so. Indeed, I think there is very little sympathy in Canada for any transfers of water out of Canada west of the Great Divide until the United States has devised some method of making use of its own share of Columbia River water.

On the Great Plains the situation is different. There we are both short of water for irrigation. On our own southernmost river system of the prairies, the Saskatchewan, we built a major impoundment in the 1960s: Diefenbaker Lake formed by Gardiner Dam. Its storage is not yet fully utilized but it will be eventually, and this means that it is not a source for export. Unfortunately, this particular situation demonstrates very explicitly the international contiguity of water-short areas that makes the likelihood of international water transfer minimal.

I would like to remark parenthetically at this point that the Garrison Project is an example of the problems we can expect to have to cope with in the future when we consider interbasin transfers. It also shows how much more complex such transfers become when an international boundary is involved in the transfer. Finally, it demonstrates how necessary a mechanism such as the Boundary Water Treaty and the International Joint Commission is in preventing a local difficulty from exacerbating national emotions and in bringing a sense of reasonableness to the resolution of serious problems.

To realize how fortunate we are, we need only look at the unfortunate situation in which Nepal and India find themselves. The huge Ganges River, which is the life line of hundreds of millions of people in India, rises in substantial measure in Nepal. Nepal would like to derive some benefit from development of this resource, but without any mutual agreement with India there is no easy way to proceed. India is nervous about any sort of change to river flows unless she is in control. The rivers all cross the boundary one way and so the shoe is always on the same foot. When the final complication of having Bangladesh downstream of India is added, I think a picture is presented that ought to make us thankful that our problems are only between states or between provinces, and between two countries who are good neighbors.

North of the Saskatchewan Basin, the Athabasca-Peace-MacKenzie system flows to the Arctic. Mr. Schad speaks of it as probably always flowing north into the Arctic unused. Canadians look at this differently, as a presently undeveloped resource, and feel that while it presently flows unused to the north it does not do so unusefully. Our scientists are uncertain about the fragile Arctic ecology and the effect of the large flow of fresh water, of sediments and of heat on the MacKenzie Delta and the Arctic Ocean itself. At the moment the river is also an important navigation link. This is not an exhaustive list of concerns about our northern-flowing rivers but the concerns are very real and make even consideration of a transfer very difficult at the present time.

On another subject, the use of Canada as a corridor to transport water from Alaska to the contiguous continental states depends on the size of the transfer. A pipeline might be politically and technically possible but it is economically ridiculous as evidenced by the cost of the oil pipeline financing. I suppose when water is worth \$22 a barrel or say \$133,000 an acre-foot then we can look at it again. A system of canals and lakes in the Rockies such as that proposed under NAWAPA is technically feasible and might some day be an economic possibility. It is not, however, a political possibility in British Columbia where flooding of the Rocky Mountain Trench and other comparable projects would inundate a very large percentage of our habitable land, undeveloped though it may be at this time.

Indeed, to some of us in Canada it seems that when the western United States begins to look to Canada for water it is not because you do not have it in the United States but because you have a lot of political problems between your states in transferring water from the Columbia system. Believe me, there are just as great political problems in Canada where water resources are the property of the provinces, and in addition there is the even more difficult one of international transfers.

Mr. Schad has spoken of some of the more exotic ideas of augmenting the western water supply. Unfortunately, most of them can only be thought of in terms of uses other than for agriculture. For instance, the best available technology at present indicates a cost of over \$1,000 per acre-foot for desalting

water. Iceberg towing has an indicated cost of between \$100 and \$200 per acre-foot to bring it up from the Antarctic to a coastal point in the United States, but it is certainly going to be expensive to get it to where it's needed.

The idea of reducing evapotranspiration to increase groundwater supplies by changing forest areas to grass may indeed have possible applications. It needs, however, to be measured against the value of the biomass production of the forest that may have a future, not only as pulp and timber, but also as a renewable resource to produce liquid fuels.

One is led by all this to Mr. Schad's pretty well inescapable conclusion. The most practical, economically viable action we can presently undertake is to reduce our water demands. The capital costs involved will be relatively small and the results will be immediate. The first step that appears prudent to an outsider is to move gradually but effectively to a system where users pay the true cost of water. This means that subsidizing water supply schemes on a permanent basis must gradually be discontinued. For uses other than agriculture, actual savings will unquestionably accrue as reuse becomes general and waste is reduced. As far as agriculture is concerned it means that a more realistic evaluation will occur as to what is the most economic means of filling our food requirements. It seems to me that two aspects need consideration.

First, the institutions and laws that govern water appropriations, transfers, and uses must be changed to take into account the priorities that our society now places on use of water. The uses considered must include energy production, navigation, industrial and domestic use, mining, agriculture, and commercial fishing, as always. But it must now also include recreation and aesthetics, which have often been ignored or at best considered as incidental. Mr. Schad mentions the allocation of irrigation water on an as-needed basis rather than according to the rights held by a user. This seems eminently reasonable, but it is going to be difficult to implement. Second, all the techniques we have developed to increase agricultural efficiency that we can characterize as best management practices must become standard practice.

I would (somewhat diffidently) suggest that a minimum of

legislative revision to enable the necessary changes be made and combined with a maximum of inducement through gradually improved pricing systems for water. This, I believe, is our best hope to reduce the demand.

As a last thought, may I suggest it is time for us to accept the fact that fresh water is a finite resource. In many places in the western United States we are far along the way to making the maximum withdrawals from all available sources. Now we must make sure that our institutions and our technology are used efficiently to plan the most satisfactory developments in accord with our priorities, thereby maximizing the benefits we can obtain from our water resources. An acceptance must be engendered of the fact that there is a limit to the expansion of irrigated agriculture and other high consumptive uses of water. Where mining of groundwater or salinization is taking place it may be necessary to cut back. But these are the realities and we will be better off when they are understood not just by our technical people but by commercial operators, businessmen, politicians, and the public.