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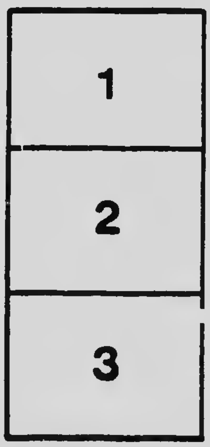

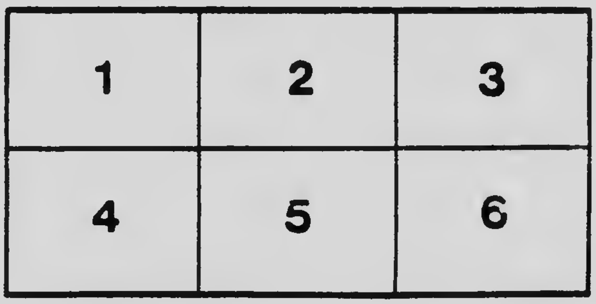

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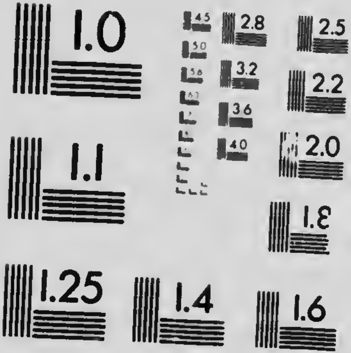

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More and Better Water For Our Farms

and Rural Communities

Report of a Conference Called by the Lethbridge Board of Trade at Lethbridge, Alberta, on June 22nd, 1917

THE FARMER'S WIFE AND THE FARM WATER SUPPLY

At the 1917 meeting of the Western Canada Irrigation Association at Maple Creek, Mr. G. R. Marnoch was asked to give an address regarding the Water Conference. Hon W. R. Motherwell, Minister of Agriculture for Saskatchewan, was in the chair. At the close of the address Hon. Mr. Motherwell said:—

"I do not think Mr. Marnoch needs to say anything about the timeliness of his paper. There are hundreds of farmers around the country trying to do something to relieve the drudgery of the household tasks. We often speak of the weak link in the agricultural chain as being farm power but the weak link is in most cases the water.

"I have come from a brief visit to Banff. I think it was occasioned by too hard work and neglect of myself in my earlier days. I found that the hotels there are filled with wornout farmers and their wives from the Prairie Provinces. Instead of laying up early for repairs, they go on for forty or fifty years before they do lay up. We would not use our binder or threshing machine that way. Every man repairs his machine about this time in order that his threshing machine will not break down during threshing. We should do the same with ourselves. After all, human life is more valuable than anything else on the farm. The most expensive and extravagant way of doing your farm work is at the expense of your wife's health. There is scarcely a place that I know of in these western provinces where something cannot be done to help out in the matter of water supply. Of course, the man who is without eavetroughs on his own farm buildings should not shout for help from the Government until he does have them. If you just sit down without water and wait for the Government to come along with it, the Government will not be in much of a hurry to do anything."

More and Better Water For Our Farms

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Report of a Conference Called by the Lethbridge Board of Trade at Lethbridge, Alberta, on June 22nd, 1917

"The Commission of Conservation has kindly undertaken to defray the cost of printing this Report. This action has been taken by the Commission in view of the great importance of the movement to obtain better water supplies whether regarded directly or indirectly, as for the conservation of health or as conservation of the important agricultural interests of Southern Alberta and Southern Saskatchewan, and the population dependent thereon."

FOREWORD

There are gathered together here in this little booklet several reprints from the Lethbridge Herald reporting the proceedings at a Conference on Water Supply called by the Lethbridge Board of Trade on June 22, 1917. It is hoped that these may prove useful to farmers who were unable to be present at the meetings.

During the past three or four years the Lethbridge Board of Trade has devoted a good deal of its efforts towards helping to establish the farmers [illegible] have been attracted to this fertile district. While [illegible] citizens of Lethbridge have a steady and increasin[illegible] [illegible]ess arising out of the coal mining industry in their [illegible] they realize that the foundation of all their prosperity lies primarily in the agricultural resources of the grain growing, alfalfa raising and livestock industries that surround the city on all sides; and this Water Conference is one outcome of their efforts in this direction.

While great benefits will undoubtedly result by the action that the Dominion Government and the Alberta Government and the various government departments will take arising out of the conference, it will not be out of place to mention that the farmers and the communities in our towns and villages have gravely neglected one easily available source of water supply. It is astonishing to find for instance, that only about two per cent. of the buildings in the new towns along the line from Lethbridge to Manyberries are provided with eaves troughs on the roofs. The water drops from the heavens on the roofs and all that is required to provide a very considerable part of the water needed for household purposes is a few lengths of spouting, a simple filter and a cistern in the cellar. We need the geologists to tell us how to get the dead rocks to deliver up their waters, and the irrigation engineers to help us to bring along the diverted waters from our streams and to show us how to hold up waters by dams; but we ourselves can surely take care of the living waters that fall directly upon our own buildings.


GALT GARDENS, LETHBRIDGE

A GENERAL SURVEY OF THE NEED FOR MORE AND BETTER WATER FOR OUR FARMS

(Reprinted from Lethbridge Herald, June 22 and 23, 1917.)

MR. MARNOCH'S ADDRESS

Ladies and Gentlemen.

Your presence at this conference on More and Better Water for the Farmer is evidence in itself that the subject matter of our discussions today is of far-reaching importance.

We are not going to be able today to arrive at final conclusions as to how more of this water is to be got it; but we are going to have a sort of stock-taking of all the information that is now available, and we are all going to put our heads together to devise ways and means for acquiring further information. I hope we may be enabled also to collect the most of this within the covers of a booklet or bulletin, and so make all the known facts available for the hundreds of farmers and their wives who are eagerly awaiting guidance as to how to get more and better water.

This meeting today is the outcome of enquiries which were started by the Board of Trade of Lethbridge away back in the early days of 1914. Some of you may remember that in that year there was considerable excitement in Alberta over the alleged possibilities of finding oil under the foothills and the fertile plains of our Sunny Alberta. Some of our more enquiring souls, desirous of informing themselves about anticlines and synclines, began to dig into bulletins relating to the oil fields of the United States, and therein discovered that it was a regular part of the business of the U.S. geological survey and of the geological departments of the various states, to devote attention to the finding of underground waters for the use of farms, villages, towns and cities. We took the matter up with the Dominion government, and we found that absolutely no attention had been directed to assisting the farmers of Western Canada to find well waters. As soon, however, as the great need for such assistance was brought to the notice of the permanent officers of the geological survey of Canada, Mr. D. B. Dowling and Mr. S. E. Slipper were directed to devote some time to the study of the question. Mr Dowling was able to report as a result of his investigations during the summer of 1915, that a considerable area in Southern Alberta in the regions south of Lethbridge was underlaid with a sandstone which carried water from the Milk river at the international boundary, and that this sandstone lay at the considerable depth of six to eight hundred feet; but that in many places lying lower than the channel of the Milk river the water rose to the surface when the sandstone was tapped by drilled wells. I need not, however, go into any details in regard to this because Mr. Dowling and Mr. Slipper will tell you all about it. They will also inform you of what steps they have been able to take, with funds which we were able to get the Dominion government to appropriate for the purpose, to add to the available information on the subject by actually drilling further test wells.

But the greater and more general question of how to prove up such sources of water supply as may be more readily accessible at lesser depths is still largely unsolved; and I am hopeful that today some light may be shed on this. To show the necessity for this I will tell you of an incident that happened in the Board of Trade rooms the other day. A farmer's wife came in to ask where she could get a sample of water analysed. We told her the department of health at Edmonton would do that for her. She said that last year they had some spare money for the first time, and they thought they would try for water. They drilled eighty feet and got a small supply of good water; but they thought they would go deeper and try for a bigger flow; they got the bigger flow, but it was so unpalatable that they want to assure themselves that no harm would come to their livestock if they drank it. As she turned to leave she said, " Oh well, it doesn't matter so much if it's no good; we've been hauling our water for six or seven years and I guess we can go on a while longer"

In Better Shape.

The farmers in Southern Alberta are getting into much better financial shape than they used to be in; the splendid crops of the last two years have given them a new outlook on life. They want to improve their houses and to acquire conveniences for better living; they are all needing more water supplies, to take care of the live stock that they are getting in increasing numbers. The moisture conditions these last three years have been ideal, and if we could be assured that the years to follow would be equally kind we might be more complacent; but we know that dry years are bound to come along, and we want to make all proper preparations for having water supplies available. Attention must be paid not only to reaching underground supplies, but to the measures for reaching water in streams, lakes and coulees, so that live stock may find sanctuary in time of drouth; we want also to ascertain what can be done in the way of making water diverted from our rivers available for domestic and stock raising purposes. All that is cognate to these subjects will also engage your attention today. The storing of water by dams across depressions; the care of water that can easily be collected from the roofs of houses and barns; the purifying of all water supplies, either by filtering or by distilling the water; piping the water into the house; the disposal of sewage and the protection of water supplies—all of these matters will be under discussion.

We are glad to see some of our friends from our sister province of Saskatchewan here; their problems in regard to water supply are the same as ours, and from the fact that their lands are more closely peopled they have had to devote more attention to trying to solve these problems. They will give us their advice, and I hope they may learn something, too.

I am certain that we can be assured of this—that when the minister of agriculture of Alberta places before his colleagues his report of this conference, he will be able to assure them that there is a great bulk of valuable information available as a ground work for practical investigation and help for the farmers of this part of our province; and I am sure that he will be satisfied from what you scientific gentlemen will tell us, that your great knowledge, your sympathy and your enthusiasm for the progress of any part of our great Dominion, are fully at our disposal, and that if only reasonable means are provided, you will pursue this subject of water supply continuously until all possible avenues of progress are fully developed.

If I may anticipate some of the good things that are likely to come out of this conference I might say that there are indications that we shall hear some good news in regard to the possibility of getting the use of a boring machine which can very quickly and cheaply drill small test holes for the discovery of water, and by that means let a farmer know whether he is justified in spending money in drilling or digging for surface waters down to depths of about a hundred feet. We may also hear good news about a cheaper method of reaching Mr. Dowling's artesian waters at the six and eight hundred feet depths; up till now we have thought $4000 or $5000 was the smallest expenditure that would get down to these depths, but we may learn that they can be reached for about $2500.

We shall also get some excellent advice about storing water in deep cisterns and about holding up the rain water from roofs. We shall learn just what the present position is in regard to stock watering reservations along our river fronts; and also about the additional supplies of water that may be more available when irrigation water is brought along to the 100,000 acres included in the Lethbridge Northern Irrigation project.

There will also be some interesting information made available in regard to easy methods of filtering water, and regarding water distilling apparatus that may be available at comparatively low cost; and also about how to make unpalatable waters drinkable and usable.

In conclusion I would say that I believe our merchants here may not have been as alert as they might have been in placing their supplies of drilling apparatus, pumping outfits, piping, sinks, baths, closets and materials for sewage disposal before our farmers and their wives. They are all able to afford these comforts now, and they are undoubtedly open to buy them if they are brought to their notice with anything like the assiduity that is displayed for instance by the automobile agents.

WATER SUPPLY AND THE FARMER'S WIFE

Lifting a Ton of Water a Day

During the water conference at Lethbridge the chairman read this quotation from "Farm Efficiency," which he said contained about as much common sense in small bulk as he had ever seen. The booklet is by Xenophon Caverno of the Kewanee Public Utilities Company, of Kewanee, Illinois.

"President Joe Cook of the Mississippi Normal college, in a bulletin of the United States Bureau of Education, makes the rather startling statement that the average farmer's wife has to lift a ton of water a day. Here is how he figures it:

"The getting of the water from the source of supply to the point of application requires more manual labor than any other item of housekeeping. The water for the kitchen has to be lifted from the well, carried to the kitchen, poured into a kettle, poured out of the kettle into the dishpan, and from the dishpan out of doors. This makes six times the water is handled; and a bucket of water containing two gallons, with the containing vessel will weigh 20 pounds. When this is handled six times, the total lifting is 120 pounds. The cooking of three meals a day on a meagre allowance of water will necessitate 10 buckets, which will make for cooking alone 1200 pounds of lifting per day. When to this is added the water necessary for bathing, scrubbing and the weekly wash, it will easily bring the lift per day up to a ton; and the lifting of a ton a day will take the elasticity out of a woman's step, the bloom out of her cheek, and the enjoyment out of her soul."

"Imagine an average farm home without modern improvements and conveniences. Picture to yourself an average farmer's wife as she goes through her daily routine. Follow every step from the time she starts the fire in the frigid kitchen till she lays wearily down the last pair of mended stockings at night. Now, by magic transfer her in her sleep into a house with just plain conveniences, a heating system, running water, hot and cold, a bathroom with lavatory, closet and bath tub, a sanitary system of sewage disposal, a power plant that not only pumps the water but runs an electric lighting plant with storage battery; a power washing machine and wringer, a power generator and churn, a vacuum cleaner and perhaps an electric flatiron and a little motor to run the sewing machine.

Give her an extra hour to sleep. The kitchen is warm, the water is hot and she can get breakfast in a jiffy on the oil stove. Now picture to yourself her day's work and her day's uplift to body, mind and soul. It is the difference between losing and winning, between conquering and being conquered. Look at these pictures from the standpoint of efficiency, of humanity, of romance. No magic of Aladdin's lamp could work a greater transformation or bring greater joy and comfort.

And what would be the cost? A long spell of sickness and first class funeral would buy the whole plant. The wages of a hired girl or two weeks of a nurse and doctor would much more than carry the interest on the investment; so would the price of a fair cow or a poor horse."

REPORT OF PROCEEDINGS AT THE CONFERENCE

Mr. D. B. Dowling, of the Geological Survey of the Dominion of Canada is the man who went to work when the Lethbridge Board of Trade set out to help solve the difficulty of the farmers in connection with farm water supplies. Through his efforts the government is gathering all the information available on well water supplies in Southern Alberta, and also have two drilling rigs busy east of the city endeavoring to carry out further tests, and with some success. The southeastern part of the province has been found to be underlaid with underground water supplied over a great area which when tapped, result in artesian wells. This area is being tested, and special attention is now being paid to reducing the cost of drilling to bring it within the average farmer's reach to drill a depth of 700 or 800 feet at which depth the water may be found. Mr. Dowling it was, who put forth the suggestion that every well driller should be forced to submit a log of each well he drills in order that all information may be gathered together and made available for the farmers.

F. H. Peters, commissioner of irrigation for the Dominion, spoke on the "prospect for water supply by percolation from irrigation development," and A. S. Dawson, chief engineer of the C. P. R. department of natural resources, spoke on "general information relative to water supply for the farm and for rural communities."

Those present at the conference this morning were:

F. C. Nunnick, Ottawa; D. B. Dowling, Ottawa; John F. Sweeting, C.P.R., Calgary; E. L. Landorph, C.P.R., Winnipeg; F. W. Alexander, C.P.R., Calgary; Alex. A. Stewart, Suffield; S. I. Harris, Milk River; Arthur V. White, Ottawa; Wm. Pearce, C.P.R., Calgary; W. A. McNair, Monarch; H. W. Petrie, Pearce; Geo. W. Craig, City Eng., Calgary; A. S Dawson, C.P.R., Calgary; S. E. Slipper, Ottawa; Sam G. Porter, of Calgary; R. J. C. Stead, C.P.R., Calgary; A. V. Harris, Macleod; G. G. Harris, Macleod; Bertram S. Smith, Calgary; Arthur Claydon, Nobleford; Wm. Isaac, Nobleford; J. E. South, Nobleford; J. L. Holman, Taber; Geo. A. Ohren, Nelson, B. C.; H. A. Craig, Edmonton; L. C. Charlesworth, Edmonton; A. V. Toole, Farmers' Advocate, Winnipeg; E. A. Howes, University, Edmonton; F. H. Peters, Calgary; B. R. McMullen, Barnwell; Lawrence Peterson, Barnwell; J. B. Sumner, West Lethbridge; P. Lund, Coaldale; H. A. Suggitt, Coaldale; H. P. Ober, Coaldale; Dr. Seymour, Com. P. H., Saskatchewan; Mr. Pearson, Iron Springs; L. P. Tuff, Coalhurst; J. R. Sandham, Coalhurst; Marmaduke Mills, Sundial; F. A. Mills, Sundial.

T. D. Washington, Toronto; John Hamilton, Coaldale; John Finter, Ottawa; H. G. Eadie, Olds; W. Cawdron, Nobleford; D. J. McArthur, Coaldale. T. L. Davies, Nobleford; M. C. McKenzie, Kipp; B. F. Johnson, Barnwell; Jas. F. Johnson, Barnwell; Abram Baldwin, Wrentham; O. H. Benson, Commerce; Thos. Scott, Commerce.

Those in attendance from Lethbridge were: G. R. Marnoch, J. Russell Oliver, Mayor Hardie, Albert Firth, Fred Senior, David White, S. J. Shepherd, F. W. Downer, R. T. Brymner, J. N. Kennedy, W. S. Ball, E. U. Rylands, J. W. Bawden, W. F. Hicks, S. S. Dunham, C. S. Farrow, C. A. Cotterell, H. G. Long, G. H. Harman, J. F. Irwin, H. A. McKillop, W. Ingram, Peter Coyne, Chas. Watmough, E. H. Tracht, A. A. Schwartz, H. G. Clarke, W. Firth, W. H. Fairfield, Robert Crawford, Geo. Kirkland, Geo. Firth, John Horne, W. J. Nelson, W. A. Hamilton, A. M. Grace, F. Hawkey, T. Gray, R. J. Gordon, C. Parry, D. A. Simpson, D. J. McSwain, W. D. King.

Need for Information

"I'll give anyone here $100 who will locate water for me on my farm," declared A. Claydon, a Nobleford farmer, who has dug eight wells on his place at a cost of $1500 without success. That represents the attitude the farmers brought to the more and better water conference

"We must gather and tabulate all the information we can possibly gather together so that when the farmers come to us we can tell them with a fair degree of accuracy what chances they have of getting water and the probable depth necessary to go. A law should be made requiring all drillers to send to some government department a log of every well they drill." That is the attitude of the delegates from various government and railway organizations who have come to the convention in order to give the benefit of their expert knowledge.

With these two attitudes represented, the convention which opened this morning promises to bring forth many actual benefits in the near future. There are enough farmers present to keep the scientific side of the conference right to the point, and actual problems are not going to be overlooked.

G. R. Marnoch, president of the Board of Trade, and one of the first men in Southern Alberta to draw the attention of the various governments to the absolute necessity of aiding in the finding of better water supplies for the farmers, was in the chair and after a short address of welcome by Mayor Hardie, opened the conference by an address in which he outlined the need of some action such as the convention hopes to bring about, and also outlined some of the practical results it is hoped to obtain from the presence here of so many men vitally interested in the problem. Mr. Marnoch also conveyed to the conference the regrets of various speakers who had hoped to be present including those of President Wood of the U.F.A., who was unable to attend owing to his connection with the newly appointed grain commission.

The attendance at the morning session was quite satisfactory, the hall being fairly well filled, and there being a goodly sprinkling of farmers, each of whom has his own particular problem which he hopes to have the conference deal with. There were also a large number from the city especially business men who are vitally interested in the problems of the farmers.

Pioneer Farmers' Needs

Owing to the inability of President Wood of the U.F.A. to be present, S. S. Dunham, vice-president of that organization, delivered a short address in which he put before the convention some of the problems of the farmers in connection with the water supplies. He said that we are pioneers in this new land which is remarkably fitted for the carrying on of agriculture. Comparing it with Indiana and Ontario where the pioneers had to clear the land of its heavy timber growth, and with Illinois which the pioneers had to tile and drain, Mr. Dunham said that the problems of Southern Alberta were not great, but there are some things that had to be done to adapt the country to man's use. We must overcome the problem of conserving the moisture we have, both in the soil and for stock and domestic purposes. Nothing, he declared, pays a farmer better than a good well, and mixed farming is impossible without it. The farmers are willing to spend the money to get it, they have the money now; but they want the information which will show them how to get it. Mr. Dunham said he was merely stating the farmers case and it was now up to the men of science to endeavor to solve the problem.

Stock-Watering Reserves

Mr. Dunham referring to a map showing the stock watering reserves that had been made during the ranching days, called attention to the fact that nearly all of these reserves had unwisely been cancelled and he suggested that steps should be taken by the Dominion government to look into this whole question with a view to making reserves along all water fronts, so that farmers' live stock might be watered there in times of drouth. This policy would of course have to go hand in hand with action by the Alberta government whose duty it would be to find means for getting practicable road approaches to these reserves for public use.

CONCLUSIONS THAT THE CONFERENCE ARRIVED AT

That the drill test is the only true test of underground water supply.

That the governments should undertake these tests for the benefit of the farmers;

That efforts should be concentrated on making the drilling of these test holes as inexpensive as possible and the best way to do this is to use the rotary method of drilling;

That no water witch or water machine has yet been developed which is in any degree efficient or to be relied upon;

That the provincial government road department should aid in the constru[illegible] of surface reservoirs in [illegible] along road allowances w[illegible] roads must be built across cou[illegible]ees;

That a law should be passed forcing drillers to keep a log of every well and send it to the government;

That a law should be passed making it unlawful to allow any artesian wells to flow unchecked,

as the conservation of underground waters is important, being in fact the most important of all our natural resources;

That the laws gvoerning the pollution of streams should be enforced in connection with settlers living along irrigation canals;

That farmers should take greater pains to conserve the rain water from roofs, waste in this direction being one of the worst forms of waste in Western Canada.

That farmers should endeavor to conserve surface water for stock by building reservoirs and dams in coulees.

In effect the above about summarizes the conclusions of the interesting sessions of the more and better water conference, but they do not cover the fact that scientific, engineering and agricultural authorities, including the farmers, have been aroused to the need of more concerted action to bring about results which will tend to the solution of farmers from the Great Lakes to the Rockies. The subject tackled by the conference was rather abstract, but before the end came the delegates got down to cases and to put it in the words of Dr. Seymour, commissioner of health for the province of Saskatchewan, "the problem of water supplies on the prairies of the province has been advanced years and years. We will get action now."

At the afternoon session, F. C. Nunnick, agriculturalist of the commission of conservation, read a paper on "A Farm Water Supply Survey," in which he outlined the need of such a survey, which was really the only means of bringing to the problem the attention it deserves and the united action of authorities empowered to deal with it.

Dean Howes, of the College of Agriculture, Edmonton, dealt with the question of agricultural engineering, showing that it has three phases, dealing with road making, irrigation and drainage. In connection with the need for roadmaking, he said it sometimes costs as much to get a bushel of grain from the field to the elevator as it does to get it from the elevator to the markets of Europe. The coming generation must be taught to overcome this. Irrigation and drainage go hand in hand, and are both important in Alberta. He felt the need of a better agricultural engineering course at the university and hoped public bodies would impress upon the university authorities this need that it may be met. He also wanted to see the college doing more research work along such lines as were being discussed at the conference in order that the farmers of the province may get the information they seek without paying hard for it by experience as so many have done in the matter of well water. His address led to a resolution moved by Messrs. Dunham and Lund, being passed by the meeting asking the university authorities to institute such a course as had been outlined.

A letter was read from President Murray together with a report by Dr. Adams on the problems of securing an artesian supply of water for the districts of the northwest. The report seemed to indicate that Southern Alberta was more favored in this regard than any other part of the prairies and the Honorary Advisory Council of Scientific and Industrial Research will turn its attention to other channels in endeavoring to solve the water supply problem.

Quite a discussion was started by papers by E. Ainsworth of the provincial government road department, and F. H. Peters, commissioner of irrigation, over the possibilities of conserving surface moisture by the construction of dams in coulees and of reservoirs in other places, especially along irrigation ditches. Valuable pointers were given to the farmers who hope to solve their troubles in this way. Supt. Fairfield, of the Experimental farm, added one valuable suggestion, when he said that the digging of a borrow pit in connection with a reservoir overcame the trouble of the reservoir freezing to the bottom during cold weather in winter. The speakers all went on to show that little attention had been paid in the past to the possibilities from such sources of supply. It was pointed out by Mr. Peters that the road department of Saskatchewan had done much more in the way of providing reservoirs where road allowances cross coulees, by damming the coulees, than had been done in Alberta, and Deputy Minister Charlesworth, of the Alberta government, was asked to give the matter special attention.

Then came probably the most interesting discussion of the day. Mr. Claydon, of Nobleford, says he had driven many miles to learn something about the possibilities of locating water by divining. He had been hauling water long enough and if there was anything to it he wanted to find out. E. L. Landorph, water service engineer of the C.P.R., Winnipeg, started the discussion by a very able paper in which he told of what the company was doing in the way of testing for water supplies for operation. He depended mostly, he said, on geological information, but he gave the Mansfield Water Diviner, a machine which works on some principle that electrical attraction water holds for a certain needle, credit for being about 85 per cent. efficient. After his paper a general discussion took place in which the farmers present gave their experiences in drilling for water. Mr. Isaacs, who lives northwest of the city, said he had had such a machine which is now in the possession of the department of public work at Edmonton and that out of ten wells he had located, water had been struck in eight of them, and in the other two he didn't think they had drilled deep enough. But Mr. Smith, of the C.P.R. department of natural resources, who had had a certain amount of supervision over the drilling of more than six hundred wells in all parts of the west, said they had such a machine in their office in Calgary and it didn't show any efficiency whatever. Mr. Charlesworth said his department had sent their machine away to be repaired, and had just got it back, but intended to give it a good test this year.

However, the trend of the discussion seemed to indicate that no efficient water diviner had ever been found, and it was better not to put much dependence on them where deep drilling was to be undertaken.

The discussion brought out that certain plants, the name of which none of those experienced with them knew, indicated the almost unfailing presence of water close to the surface. The plant is of an onion-like variety with a small burr at the top, and it can be detected by the fact that it is green when other vegetation in the vicinity is dried up. S. S. Dunham and others had had good practical results from noting the presence of this weed, and the chairman asked the government officials present to secure more information and to have botanists of their departments undertake some research work along this line.

The afternoon session closed with a paper by A. V. White, water power engineer of the commission of conservation, in which Mr. White issued a warning against the waste of underground waters, especially in Southern Alberta where a large artesian well area has been discovered. He declared that our underground waters are the basis of all our resources, and must be conserved. He advocated that a law, similar to one in effect in South Dakota, be enacted making it an offense to allow an artesian well to flow untapped or without valves to regulate the flow. In some of the states of the union the water supplies underground had been seriously depleted until the government took action. Mr. White's address brought forth a resolution dealing with the problem.

At the evening session, which was held in the auditorium of the Central school, M. M. Seymour, M.D., D.P.H., commissioner for public health for the province of Saskatchewan, gave a very excellent illustrated lecture on water for farmers and small communities. After dealing with methods of guarding against pollution of water supplies, Dr. Seymour launched into a subject on which he is an authority—the conservation of rain water from roofs of farm buildings. He declared that millions of tons of water are allowed to go to waste annually on the plains of Western Canada through failure of our farmers to recognize the possibilities of this scheme. This is a waste which can be overcome at a comparatively low cost, and one of the problems of the farmer could be solved, at least in part, by following such a course. Dr. Seymour has written a pamphlet on this subject, giving the details of the plan, and this will appear in The Herald at an early date.

At the evening meeting also, F. H. Peters gave a paper on water stills and water filters, and with samples of various stills and filters, showed what could be done on the ordinary farm in a practical way to overcome the threat against public health through the drinking of impure water.

WATER SUPPLY IN SOUTHERN ALBERTA

Address by D. B DOWLING, of the Geological Survey of Canada

In a general discussion of water supply it may be profitable to call to mind some of the general principles governing the distribution so that from them, or such as can be brought before us, we may gain profitable subjects for discussion. The first to present itself is that for a continental area the source of supply is the condensation of the moisture derived from the evaporation from the sea. This is distributed unevenly commencing with a greater rainfall near the coasts and on the highlands and less on the interior lowlands. The greater fall on the highlands is to a large extent distributed by various channels over the lowlands. Gathered into lakes or exposed on the surface it is largely again evaporated and distributed by rain clouds to other areas so that even for comparatively small areas the water supply may be considered as being largely dependent on the rainfall, reinforced by the run-off from adjacent areas (streams, etc)., and partly on the general humidity of the air. That is the area of light rainfall is under greater loss by evaporation into the dry atmosphere than is the area in which the rainfall is more abundant.

Amount of Rainfall: In the area represented by the southern plains the condition seems to be that of a general light rainfall and a period of dry winds in the summer months. That the evaporation from this area is very great can be shown by a careful measurement of the streams, showing the amount of water leaving the area in comparison with the recorded amount of precipitation. The figures may be available and it is merely an impression that the amount evaporated is 9-10 or more of the amount falling on the surface. This loss in a country not overly supplied suggests one very pertinent enquiry, what can be done to restrain or retard that loss? The evaporation through growing plants or animals is the form most desired, but to do that it must be stored. The storing or saving of the rainfall is then submitted as one of the principal items for discussion and the following brief notes are submitted:

Evaporation and Run-off—Before the prairie surface has been broken the run-off from the closely compacted sod would seem to have been at its maximum. Over much of the prairie areas this run-off did not at once reach the streams, but gathered in all the hollows and formed the great series of sloughs that were so common a feature. These were generally shallow basins and formed great evaporating pans whose areas were constantly changing. The water held thus for short periods was absorbed by a limited area surrounding these basins and but a small part of the rainfall seemed to have been utilized. The cultivation of the soil must affect the amount of run-off by a great absorption and would be shown in the decrease in the sloughs. Whether this preliminary soaking of the soil prevents or retards evaporation would be dependent a great deal on the question of the preparation of the surface. Before the grain or grass became long enough to form a shade and break for the drying winds, the evaporation would be very great, but the practice of dry farming methods aims at not only preparing the soil for receiving this moisture, but by compacting the surface prevent the evaporation. It would seem that if this could be perfectly done the subsoil should gradually become more moist. The storage of rainwater should be made in view of this possible loss in the air and cisterns and artificial ponds made deep rather than broad.

Run-off—As the amount which does not penetrate into the soil is at first a very large per cent. of the rainfall, and rapidly evaporates, the catching and storing of it does not mean the robbing of the streams to the extent that at first glance might be supposed. The prevention of evaporation is the principal consideration and as said before should indicate deep cisterns rather than wide shallow troughs. The deep cuts made by our streams suggest the easier points at which to establish reservoirs by damming and should form one of the principal subjects of discussion.

Surface Wells—Where the rainfall is absorbed to any great extent in the soil, that is enough to accumulate in the porous layers beneath, wells are readily found at comparatively shallow depths, but as has been found in this portion of Alberta this condition is not the prevalent one; we must assume that the most of the rainfall either runs off or evaporates.

The consideration then of the character of the subsoil must in a great measure be expected to explain the cause of the non-retention of this surface water. This is a subject that has such a wide application, owing to the great area and the lack of trained me., that a mere sketch of the general history of the formation of this subsoil can be here attempted. We can carry our mental picture of the surface feature back in time to before the cold period in which it is generally recognized that the granite boulders and much of the surface clay was brought and spread over the soft rocks that formerly formed the surface. At Lethbridge the old valley running eastward from the mountains was not so steeply cut as at present. It was many miles wide and had sloping banks. Its bed was liberally strewn with pebbles brought from the mountains and formed a broad layer. Other wide valleys, no doubt, crossed the region, but are obliterated along with this one by the material plastered over the country by the advancing ice sheet and rearranged by the waters following its melting. As the general slope is to the northeast, the water from the melting ice was impounded in front of the ice and drained away over what is now higher country. Thus imagine the ice sheet to have been at Lethbridge and its front running off to the southeast. The old valley would form the lower part of a lake which would spread until it spilled out over the lowest outlet. Into this would be poured all the silt and dirt brought in by the streams from the mountains eventually levelling up the surface. The first channel that the water pouring out from this lake adopted was in front of the Milk river ridge and became the present Verdegris coulee. There was then no river here and the old valley was being filled up. Gradually the lake was lowered as Verdegris coulee was cut and the ice melted back, and a lower outlet was formed along the ice front by Etzikom coulee. We can trace the lowering of the water again to Chin coulee and again to Forty-mile. With this lowering the drainage from the mountains began to re-cut the valley past Lethbridge through the clays, boulders, sands and then the pebble bed which were in the old valley and finally into the rocks beneath, exposing the coal seams and shales beneath. Much of the sands and clays thus dug out were spread in the part of the valley lying to the east forming the sand plains north of Purple Spring. This digression from the subject of water supply is to suggest that the material deposited on the old rock surface may be of a varied character. The presence of a lake front to the retreating ice suggests that the clay material deposited would not be the ordinary boulder clay, but would be sifted and the surface deposits would generally be of a finer grade, a better soil maker than might otherwise be expected. But the reassortment might also be expected to mean that the surface material being finer grained would also be more impervious to water, and the underlying beds while capable of receiving this water remain dry unless it received it from the adjacent areas of coarser land. There is thus a field of study in the soils at the surface for the more porous areas to which to direct the attempt at saturating the soil beneath the apparently dry areas. There is again the question of the loss of water from the surface soil and even the underlying rocks by the very deep channels across the southern part of the country that have been cut by streams no longer in existence and by the present river channels. This is very marked here at Lethbridge. You may remember the old river valley that was mentioned that had been filled up. This has been traced by a few well borings, but is not very well defined as yet. In crossing the valley by the road you will notice that you are a long way down the hill before you pass through the yellow grey clay probably a thickness of 300 feet. At places along the valley where slides have not interfered with the display of the section, the pebble bed at its base will be seen. This pebble bed extending back under the banks and upward away from the river is no doubt a drainage channel for the under surface water of a wide belt on both sides of the river and must account to a large extent for the difficulty of obtaining shallow wells here.

Sub-surface Wells—The channelling of the surface to depths of from 150 to 200 feet by such valleys as Milk river, Verdegris, Etzikom, Chin and Forty-mile coulees has allowed both the drainage and the possible saturation of the porous rocks beneath the surface. There are fortunately beds which are capable of carrying water that reach from the surface downward to about 300 feet. This reference is to the central part of the area. The thickness to east and west is greater owing to the large flat arch form assumed by the underlying rocks. These beds contain porous layers which may contain water in the upper part, but they are not to be depended upon throughout a long period of drought, as they are losing their water through evaporation by capillary attraction toward the surface and by the draining action of the deep cut coulees which cross the district. The porous beds that are at from 300 to 350 feet beneath the surface in the country north of Etzikom coulee are found also to have a supply which probably is derived from a sub-channel drainage down the coulees, induced probably from the spilled water at their heads from the irrigation canals. During the past year many farm wells in the country between Chin coulee and the Crow's Nest line of the C. P. R. have been reported as obtaining water at depths of between 350 and 400 feet, so that it seems quite within reason to suppose that the spilling of irrigation water into the coulees has had an effect. The fact that the rocks have a general slope toward the north practically with the general slope of the country suggests that if it is possible even in a small way to send water under the surface toward the north, the more definite flooding of these coulees would well repay the loss of bottom land or the added cost of road construction across them. It might even be assumed that were the supply maintained in these coulees some of the wells to the north might even flow at the surface or the water come to a much higher level than at present.

One acknowledged drawback against the water obtained in this manner from the lower beds is that it contains the soluble salts found in the beds, but it must be pointed out that continued passage of the water along the beds tends to a purification. That is saturated beds from which no water is drawn will be found to be salty or alkaline at first, but tend to become less so with use.

Artesian Wells—So far as known the dry belt of the southern part of the plains contains but one area in which the structure seems favorable to the obtaining of water in any large amount by deep drilling. This has been outlined for depths less than 800 feet as being east of the head of Chin coulee and to the hilly country south of Winnifred, but extending south eastward to include Pakowki lake. Under this country beneath the water bearing beds which were discussed as affording a somewhat constant supply at 350 to 400 feet, there lies a very close shale, in places a brown clay, through which water does not easily penetrate. It is about 300 feet thick and overlies a fairly porous sandstone. The situation can be well understood when you consider that at Burdett this sand lies at about 750 feet beneath, but comes to the surface in the Milk river in ranges 11, 12, 13, 14 and 15, and very much above the surface at Burdett, that is nearly 500 feet, so that it dips northward in that distance 1200 feet. As it is quite porous the water of Milk river is no doubt keeping it filled with water and the cover of clay shale retains it so that there is developed a considerable pressure. By studying the surface elevation and allowing for a loss of pressure by friction through the sandstone it is seen that there should be a large part of this area in which the water will flow at the surface. The study of the cause and source of supply was made necessary by the discovery of an artesian flow at Etzikom coulee following one at Taber. The assurance of this supply led to the deepening of the well at Foremost and of others in the district to the west near Taber. The last one reported is at Nledpath at a depth of 784 feet. The central portion between Purple Springs and Bow Island having no published occurrences it was urged upon the Dominion government that test wells should be put down. The required funds were obtained late in the year, but drillers were started in the fall on two wells on the road allowances, one south of Grassy Lake and another south of Bow Island. These we had hoped would be completed during the winter, but severe weather and the lack of trained men caused a delay and it will not be until after the meeting is over that the announcement of their completion can be made. In the meantime the drilling of new gas wells at Burdett has shown that all the old wells and the new ones as well, have passed through this water layer and that its presence was not very much desired by the drillers owing to the great flow of water. The wells that bear out the theoretical placing of the water stratum at about 700 to 800 feet beneath the surface are now about ten in number and are given in the forthcoming report of the geolog-

. al survey and from memory may be summed up as:

Nedpath, 784 feet

Taber, 670 feet.

Daze Bros., sec. 36-8-15, over 800 feet

Well near Fincastle on farm of Mr [illegible].

Well near Purple Springs gradually silting up 655 feet.

Several at Bardett; water found in about twenty wells.

C.P.R. well at Foremost, 725 feet.

[illegible] No. 3 well in Etzikom coulee, [illegible] feet

Beaver well, Milk River, 165 feet.

Wells drilling by geological survey between sec. 11 and 12-8-13 and between sec. 19 and 30-9-10.

Several of the wells are reported as decreasing in flow and this seems to be owing to the silting up of the well by the fine sand. They are apparently not supplied with a proper strainer at the bottom, a precaution that seems often to be overlooked in the proper completion.

Well Drilling—For shallow wells the prospecting should not be done by a boring machine using as large a diameter as the finished well. Small diameter drill holes cost much less and the area prospected may be greatly enlarged. The jetting tool can profitably be employed where the material is soft, but over a large area here it is questionable whether it is of any advantage. We are trying a combination machine and have found the great difficulty that there is owing to the very hard layers encountered. Our experience seems to indicate that a rotary drill will eventually be the solution of the drilling problem. For the benefit of all it is one of the necessary things to consider that the experience gained by every test well sunk should be recorded and if possible samples of the rocks passed through kept. Certain areas may thus become known as suitable for the use of one type of machine for economical work and the depths to water known. Uncertainty about depth and character of drilling tends to keep up the price of the work.

In the summary report of the Canada Geological Survey, 1915, pages 102-111 (copies of which may be had from the Department of Mines, Ottawa), there is an interesting article by Mr. Dowling on "Water Supply, South-eastern Alberta," describing the work that was undertaken by the survey in 1915.

NOTE ON RECENTLY-FOUND ARTESIAN WATER

Before this Bulletin goes to press it is learnt that one of the wells drilled by the Dominion Government has proved water at the road allowance between sections 11 and 12, township 8, range 13, W. 4th meridian, about ten miles north east of Skiff. A flowing well has been developed there.

The other well being drilled by the Dominion Government about ten miles south of Bow Island, on the road allowance north of section 19, township 9, range 10, W. 4th meridian, was not completed in the Fall of 1917, but drilling will be resumed in 1918.

In the meantime another Artesian Well has been brought in, close to Gahern post office about 12 miles south of Etzikom; this is on the road allowance between sections 19 and 30, township 4, range 8, W. 4th meridian. This well is delivering a splendid flow of water, estimated at over 30,000 gallons per day.

Flowing well drilled by Geological Survey, Dominion of Canada, north of Legend, on Lethbridge-Weyburn line.

THE RESEARCH COUNCIL ON WATER SUPPLY

Report to the Honorary Advisory Council for Scientific and Industrial Research by the committee on underground waters. The committee consists of Dr. Adams, convenor, Mr. Ross and Dr. Murray.

1. The committee, after a thorough discussion of the question with Principal Murray; R. G. McConnell, deputy minister of mines; D. B. Dowling, of the department of mines; E. F. Drake, of the irrigation branch of the department of the interior, and J. B. Challies, of the water power branch of the department of the interior, desires to submit the following statement:

2. There seems to be little chance of securing water from the eastern slopes of the foothills of the Rocky mountains because the strata of the eastern slopes of these hills pitch down very steeply and are faulted off along the margin of the plains and parallel to the face of the mountains. Where in the district a short distance to the east of the mountains, borings have been put down, either salt water or gas has been obtained.

3. It may be that a certain portion of water which falls on the crest of the Belly river anticline—extending from Kerrobert to Viking—may pass underground to the east of this anticline and be obtained by boring in the area bordering this side of the anticline in question. Wells along this district have not as yet been sunk, but even if water is secured it probably will not be found over a wide belt of country and will be of relatively little value seeing that this tract of country is already fairly well supplied with water. To the west of this anticline it is not likely that water can be secured, seeing that the series seems to be cut off by faults in this direction.

4. Further to the east beyond the relatively narrow strip of land, bordering the anticline, in which potable water may be found wherever deep wells have been bored, as for instance at Deloraine, Wilcox or Moose Jaw, these have yielded salt water.

5. The only places where good artesian water has been found is in an area in the southern portion of Alberta, north of the Milk river, about Foremost. Some flowing artesian wells have already been bored in this area, and the geological survey of Canada is putting down others at the present time.

6. These are, however, waters which rise from borings through the superficial (drift) strata in various parts of the eastern plains. The flow of these waters is determined by the irregular configuration of the drift. The course followed by these underground waters is very irregular, and it is thus impossible at the present time to predict where such supplies of water may be obtained by boring. Mr. McConnell has stated that he will undertake to have an examination of one area in this district, on the east plains, carefully mapped and studied during the coming summer, with a view to ascertaining whether it will be possible to predict the occurrence of water at any particular point from a geological examination of the drift covering the area in question.

7. Apart from true artesian waters it may be noted that there are many springs which occur around the elevated areas, such as the Touchwood hills and Wood mountains. These are merely surface water draining down from higher levels.

8. The committee, therefore, does not think it advisable for the council to take any further action at the present time with reference to the securing of artesian water on the western plains. A further examination, however, may be warranted when the officers of the geological survey have completed their examination of the area to which reference has been made.

The following is a letter received by the Board of Trade from Prof. Murray, Saskatchewan university, who was invited to attend the conference on water supply:

The question of water supply is a matter of vital importance to Western Canada. I regret that it will be impossible for me to be present at your meeting on the 22nd. I am sending you a copy of the report presented to the Advisory Council for Scientific and Industrial Research.

At the first meeting of this council this matter was brought up and at the second meeting in January of this year a committee was appointed consisting of Dr. Adams, professor of geology and dean of the faculty of applied science, McGill university; Mr. Ross, an engineer of Montreal, and myself. The report of the committee is enclosed.

We made very careful enquiries as to the possibility of securing an adequate supply of artesian water for the northwest. We got very valuable information from a number of persons, possibly the most important came from Mr. Dowling, who, I believe, has promised to be present at your conference and to give a paper.

The conclusions of our investigations were that, except for a considerable district in Southern Alberta, it is impossible to secure from artesion wells, water for a large territory in the northwest. It is also possible that the district along the railways from Saskatoon to Edmonton might yield artesian water. Briefly, the difficulty seems to be this: The strata underlying Western Canada are badly flexed, broken and folded at the foothills of the Rocky mountains, so that all water from the mountains follows the cracks of these strata to the sources of the rivers of the territories. Further, it appears that deep borings reach salt water. This is said to be due to the fact that the underlying stratum is higher at the eastern boundary near Hudson's bay than it is in the west. Like a saucer it holds within it the salt water from an earlier period and until that stratum is pierced it will be impossible to secure other water. It is, however, impossible to bring the underlying water up through the salt water. The conclusion that we came to was that this large territory must depend upon surface accumulations for its water supply. These accumulations in lakes and ponds, some of them artificial, may be carried underground for a short distance and by tapping these underground channels certain communities may receive water. For example between Quill lake and Long lake in Saskatchewan there is an underground channel which when tapped yields an abundance of water.

The advisory council had in mind at the beginning of this investigation an extensive plan of making available water for the west by artesian wells. The geological evidence did not warrant an attempt to develop this plan consequently the most practical thing to do now is to develop supplies of surface water locally and to make as available as possible for the immediate vicinities all local accumulations.

If it is possible for us to do anything for you in this matter it will give me very great pleasure to take it up with the advisory council. I regret that some very important meetings at the university here prevents me from attending your conference. I wish you the greatest success.

WATER DIVINING

In course of a highly interesting discussion of this subject, President Marnoch related an experience that one of the leading farmers in the Lethbridge district had. It had been decided to drill several wells on the farm, and it was thought that there would be little harm in spending a few extra dollars for the services of a water witch. He went around with his wand, and "located" water at several places, which were marked by stakes. The whole of the farm helpers were greatly interested, and when they sat around the dinner table they talked over the whole of this mysterious subject with the witch, who said he could work just as easily if he were blindfolded; in fact he offered to demonstrate his powers in this way. So after dinner the farmer blindfolded him very thoroughly, helped him into the buggy, and drove around the farm in various circles, at last stopping among a number of the stakes. The witch was turned loose here, and curiously enough, he did not locate any water at the places where he had found it in the forenoon.

Water supply paper, No. 255 (issued 1910) of the U.S. Geological Survey says (page 16): "No appliance, either mechanical or electrical, has yet been devised that will detect water in places where plain common sense will not show its presence just as well. The only advantage of employing a "water witch," as the operator of the divining rod is sometimes called, is that crudely skilled services are thus occasionally obtained, since the men so employed, if endowed with any natural shrewdness, become through their experience in locating wells better observers of the occurrence and movements of ground water than the average person."

Water supply paper No. 416 (just issued, 1917) says (page 6): "To all inquirers the United States Geological Survey therefore gives the advice not to expend any money for the services of any "water witch" for the use or purchase of any machine or instrument devised for locating underground water or other minerals."

Some very interesting facts were mentioned by various farmers as to indications of the presence of water by plant growth. Mr. S. S. Dunham instanced a burr, and Mr. Alex. S. Stewart of Suffield a plant like a wild onion, both of which led to the discovery of water at shallow depths. President Marnoch requested Mr. F. C. Nunnick, agriculturist of the Commission of Conservation, and Mr. J. F. Irwin, in charge of the Farmers' Illustration plots managed by the Dominion Department of Agriculture, to investigate this matter, as both of these gentleman travel widely over the prairies it is hoped that they may discover something useful in this direction.

WATER FOR FARMERS AND SMALL COMMUNITIES

(M. M. Seymour, M.D., D.P.H., Commissioner of Public Health for the Province of Saskatchewan.)

The quality and quantity of the water supply constitute very potent agencies in influencing for better or worse both the health and prosperity of every community. Water is an indispensable article to the life of both animals and plants. Where there is no water there is no life: the animal dies, the plant withers.

Even in very ancient times careful attention was paid to a healthy and plentiful supply of water. There are still to be seen today in Rome well-preserved elaborate aqueducts built by the ancient Romans to convey pure water to the city. Most ancient towns are found located near a reliable source of wat[illegible], which shows of what vast importance to the welfare of a community such an asset was considered.

The prosperous farmers of our Western Provinces too are today indebted to and dependent upon an efficient supply of water for the success of all their agricultural enterprises, and that in three directions.

(1) For the successful raising of grain; (i.e. by rain).

(2) For the watering of cattle.

(3) For domestic use.

In a country therefore that owes its rapid development and evolution to cultivation of the land, the subject of water must naturally be one of engrossing interest.

The composition of pure water is H2.0. As Rosenau says: 'Pure water is a chemical curiosity; it does not exist in nature. All water in nature contains impurities, in solution and in suspension. Some of these impurities are organic, and some are inorganic. They consist of various gases, fluids, and solid substances.

In Europe waters are frequently classified as potable or non-potable. A more practical classification of water is as follows: (1) Good. (2) Polluted. (3) Infected. A good water may be defined as one of good sanitary quality, as determined by physical inspection, bacteriological and chemical analysis, a sanitary survey of the watershed, and, finally, by clinical experience. Polluted water is one containing organic matter of either animal or vegetable origin. A polluted water is sometimes spoken of as being contaminated, and is a suspicious water. An infected water contains the specific micro-organisms of disease, as, for example, the germs of typhoid fever.

Water is a clear, transparent, tasteless and odorless fluid; colorless in small quantities; pale blue through a deep column. It [illegible]reezes at 0 C., and boils at 100.

While water is not classed as a food it really enters into the structural composition of all foods, as well as the tissue of the body. It is an essential element of diet, even though it cannot itself build tissue, repair waste, or produce heat or energy.

Water composes 70% of the entire body-weight, and its i[illegible]tance to the system, therefore, ca[illegible] be over-rated. The elasticity or p[illegible]ability of muscles, cartilages, tendons, and even bones, is in great part due to the water they contain. The amount of water required by a healthy man in 24 hours is about 3 pints. 28% of the loss of water from the body takes place through the skin, 20% through the lungs, 50% through the kidneys, and 2% through the other secretions and the feces.

The use of water may be summarized as follows: It enters into chemical composition of the tissues; it forms the chief ingredient of all the fluids of the body, and maintains their proper degree of dilution and thus favors metabolism; by moistening various surfaces of the body, such as mucous and serous membranes, it prevents friction; it furnishes in the blood and lymph a fluid medium by which food may be taken to remote parts of the body and the waste material removed, thus promoting rapid tissue changes; it serves as a distrib[illegible]r of body heat; it regulates the body temperature by the physical process of absorption and evaporation.

Drink Plenty Water

One of the most universal dietetic faults is neglect to take enough water into the system.

From a sanitary point of view we should encourage the use of a sufficient amount of water for the requirements of health and cleanliness. This amount may be variously estimated at from 12 to 17 gallons per day. Davies' estimate of 17 gallons is divided as follows:

Drinking, 3 pints; cooking 5 pints	1 gallon
Ablutions, including sponge baths, 2½ gallons	5 gallon
Washing (laundry 3, house 3)	6 gallon
Water closet	5 gallon
	17 gallon

This amount does not indicate the amount per head used when water is obtained from a public water supply, in that case water is used for watering lawns, and should be about 50 gallons.

Relation of Water to Disease.

When we reflect that water is not merely the commonest article of diet but that its consumption is an absolutely indispensable and necessary item in our daily menu in some shape or form, this feature, and its subseptibility and liability, owing to the manifold uses to which it is applied, to pollution from external sources, and the serious consequences that sometimes ensue, should serve to inculcate the warning that it is unreasonable to expect that, because nature has created in us the desire to drink, and because it also has provided the water to satiate the thirst, it should therefore also guarantee the purity of the water without some effort on our part to protect and preserve it.

Water varies in one very remarkable feature from other articles of diet, in that it is generally consumed raw, while quite 90 per cent. of our other food is disinfected by cooking. Thus while precautions are taken to pasteurize or sterilize milk, we take a chance with the water we drink. It would be misleading, however, to paint in too glaring colors, the dangers that we may be exposed to in careless drinking of water. While it is true that water may in some circumstances contain lead poison, still it may be laid down as a general rule that the chief dangers in water are due to pollution from human sources, for which our own carelessness is responsible, and which could be obviated or remedied. The commonest diseases resulting from the consumption of bad water are typhoid and dysentery.

The water supply should be made secure from the slightest contact with urine, feces, expectoration, discharges from the body, or secretions from the nose, or washings from the skin, which however do often eventually find their way into our streams. Whether typhoid fever is prevalent in the neighborhood or not, it should be laid down as an invariable rule that sewage-polluted water is dangerous.. Sewage-pollution of water invariably causes typhoid fever.

The susceptibility of water to pollution depends largely on the source from which it is derived.

Sources of Water

1. Surface water (that is, rivers, creeks, streams, lakes and ponds), from the very nature of its exposure, is subject to impurities, and, as it is almost impossible in a populous district to obtain any great quantity of surface water free from pollution with human waste, it is generally regarded with suspicion by sanitarians, and when such water is used for a drinking supply it is advisable, in addition to measures being taken to guard it from contamination, that it be purified before being consumed. It is the most liable to contamination, and therefore requires the most attention.

2. Ground water. This includes all water obtained from wells, or springs Wells may be shallow or deep, dug, drilled, driven, pounded or bored. This is the most common and the most popular source of water supply in rural districts.

Salient Features of Ground Water

1. As a rule, so far as injurious impurities are concerned, this source of water is satisfactory.

2. It is less liable to pollution than surface water because of its location.

3. It is more easily, more thoroughly, and more permanently protected and safeguarded from external contamination. Practically speaking, the only danger arising from the use of wells is due to foreign matter entering from the surface. The successful operation of a well as a pure water supply depends upon:—

(1) Its location, and (2) its construction. This is applicable in particular to the dug well

(1). The location. The site should naturally be as far as possible from such sources of pollution as contamination of the soil from privies, sewage, or manure, or farm-yard offscourings

(2). Scientific construction of shallow wells. By a shallow well is usually understood one which is dug and lined with stone, brick, or wood. The cylinder is usually about 5 or 6 feet in diameter, and the depth seldom over 30 feet. With the end in view of ensuring such a well from pollution, which usually takes place from the surface, and not from the subsoil, there are a few important features that should be remembered when planning the construction.

1. The brick, stone or wood casing should extend to about ten feet below the surface, to ensure the cylinder being water-tight to that depth. Too great emphasis cannot be laid on this precaution, as it wards off stray waste water that may drift through the soil from the surface.

2. The casing or curbing should extend at least 18 inches above the surface of the ground.

3. The outer space between the impervious casing and the earth should be filled in with well-tamped clay soil.

4. Around the extended 18 inch casing a shield of concrete or brick should be built, laid in cement, extending in a circle from the top of the well, 3 or 4 feet wide. This shield should join the well-casing so as to make a tight joint with it.

5. The top or lid of the well should rest on the casing, no space being left for frogs, mice or bugs to crawl in.

6. The top should be water-tight. This is important, as drippings from the pump would otherwise find their way in from time to time, and, as the floor got older and consequently more swelled, stray water would be considerably discolored by oozing through it into the well.

7. The pump should be let into the floor, and fastened to it, and protected with a flashing of tin to prevent water washing into the well.

8. No ventilation is necessary for the preservation of well-water, as is commonly, but erroneously, supposed. Well-water keeps better in the dark and protected from the outer air.

9. A windlass and bucket should not be used instead of a pump as this entails the continual handling of the rope by the hands of the operator, and contamination of the well may take place too by the use of unclean vessels for drawing the water.

In conclusion, perhaps the water that is most universally sound and is least liable to contamination is that from either artesian or deep wells, provided, of course, that the water is pure to begin with. As a rule the water from these wells is beautifully clear and highly sanitary. In limestone regions one should always be particularly careful to guard all wells from pollution as surface water makes its way through limestone at a most unexpected tangent at times, and when you least expect it, your well is perhaps being daily polluted by the drainage from your privy or farmyard.

Practically the same rule applies to ground where there are underlying sand formations, as water can make a passage through this with the same facility as through limestone.

Sterilizing Water By Use of Chlorinated Lime

As it is of paramount importance that the water used for washing dairy utensils should be of unquestionable quality, it would be a pardonable digression here, without entering into the details of dairy sanitation, to dilate a little upon the facilities available for rendering doubtful water absolutely harmless, with .. loss of time and with the least trouble and expense in places where reliable water is difficult to procure. The following process will be found very effective, and at the same time simple, convenient and economical: Add about a teaspoonful of chlorinated lime to a pail of water. Mix this well; of this mixture use a teaspoonful to four pails of water, that is about 12 gallons. This will act as a thoroughly reliable disinfectant. Milk cans after being washed may be sterilized by filling them with the above mentioned mixture, allowing it to stand in them for one hour.

This is a convenient, inexpensive method where the dairy man has not the conveniences necessary for sterilizing milk cans with steam.

Owing to the difficulties experienced in some sections of the country in obtaining water, a plan has been worked out by which at least a sufficient amount of good water for the domestic use of a family can be procured by conserving the rain water from the roofs of buildings. This is done by filtering the rain and storing it in suitable tanks. The material for making the tanks may be galvanized iron, brick lined with cement, or concrete, preferably reinforced.

In Saskatchewan those contemplating the installation of a rain water supply are advised to communicate with the Commissioner of Public Health, who will furnish the necessary plans and specifications suitable for the particular case. The details which I shall give now are intended for a tank in the basement or cellar of a house, consequently frost conditions are not particularly dealt with.

(3.) Rain Water, its conservation. Proper attention is not always given to the storage of roof water. Roof water usually collected in a barrel or tank is foul, dark in color, bad in taste and the greater portion of the water runs to waste by means of an overflow, the tank or barrel not being large enough to hold the water due to an excessive storm. The dark color of rain water, its peculiar taste and its general foul character are due to dirt washed from roofs and eave gutters; by proper attention these objectionable conditions may be avoided and the water rendered fit to drink. The storage of water for any length of time does not impair its character providing that all dirt be kept out of the tank.

Dirt may be kept out of the tank by passing roof water through a sand filter before it enters the tank. Tanks should be built of concrete and not of wood; the latter gives a yellow color and taste to the water. Tanks in order to avoid waste by overflow should be a size equal to $6\frac{1}{4}$ gallons of water multiplied by the roof area in square feet. Thus 1000 square feet of roof surface requires a tank capable of holding 6,250 gallons of water. All roof areas should be utilized by laying under drains to one common point. House, barn and outbuilding roof area for the average farm approximates about 3000 square feet, producing in Saskatchewan on the average 18,750 gallons per year. No more water should be drawn per day than at the rate of $1\frac{3}{4}$ gallons per each 100 feet of roof area. To exceed this amount is to run short at some period of the year. Thus 3,000 square feet of roof area produces $52\frac{1}{2}$ gallons of water per day, based on the average rainfall. As during the average annual rainfall of $6\frac{1}{4}$ gallons per each square foot of roof surface, the tanks will never be full, the water being in continual use, the tank is capable of storing any excess over the average, thus carrying the supply over a succeeding year when the rainfall may be below the average.

The sand filter should be 6 feet by 3 feet in depth, presenting 5 square yards of sand surface. The sand should be medium in grain size, clean and sharp. The base of the filter to be drained with ordinary 3 inch tile pipe surrounded with pea gravel, the gravel having a depth of 9 inches over the whole base of the filter, thus leaving 2 feet 3 inches to be filled with sand. The top level of the sand to be one foot below the overflow weir to the tank, thus maintaining a water blanket, so as to provide a head of water over the sand when in use. As the filter will only pass 1,643 gallons in 24 hours, or slightly over a gallon a minute, stand-by storage must be provided for any sudden excessive rainfall.

Stand-by storage equal to 1 inch of rain over the roof area must be provided. Thus with a roof area of 3,000 square feet, 250 cubic feet of storage is required, viz.: 10 feet by 10 feet by 2 feet 6 inches, the latter being the depth or head over the filter surface.

Filtering water is essentially a slow process, and if the stand-by storage is not sufficient to take care of excessive rainfalls, water will be lost. Any attempt to force water through the filter at high rates, either by using very coarse sand or increasing the head, will affect the purity of the tank water.

The surface sand of [illegible] must be scraped off, washed and [illegible]ved, and the whole body of sand broken up and stirred before May each year. To do this it is necessary to apply a hand pump to the well between the filter and tank and pump out the water from the filter.

No overflow should be made either from the stand-by tank or filter. If the water overflows over the top of the filter then it is evident that the surface of the filter requires cleaning and renewing. If after cleaning and renewing the sand, it is yet found that the filter overflows during excessive rains, then the stand-by storage must be increased so that no loss of water is sustained. Care should be exercised in keeping all eave gutters clean from accumulations of dirt deposit.

All drains leading from down pipes and laid under the ground surface to the filter and tank should have cement joints and be water-tight to prevent waste of water or entrance of foul water from the filter.

Local conditions and the location of the storage-tank will determine in each case the amount of frost protection required. Where there may be a nearby stream, or any source of water not polluted by sewage, but only impure from mud or other earthy matters, such water may be carted or led to the filter and provision made for its entrance into the stand-by tank. The filter will successfully and efficiently purify such water and make it fit for domestic purposes, but more attention must be given to keeping the filter surface clean, depending upon the amount of sediment in the water.

A float with rod attached may be provided to show at all times the amount of water in the tank and the amount remaining.

Increased surface for collecting rain water may be provided, if necessary, by fixing sloping corrugated iron sheets to posts driven into the ground, the value of every square foot of surface being 6¼ gallons of water per annum. Thus 3,000 square feet of galvanized iron sheeting erected would cost about $200 and would yield 468 barrels of water at 40 gallons the barrel per annum, or, valuing the water at 45c the barrel, the roofing would be paid for in one year.

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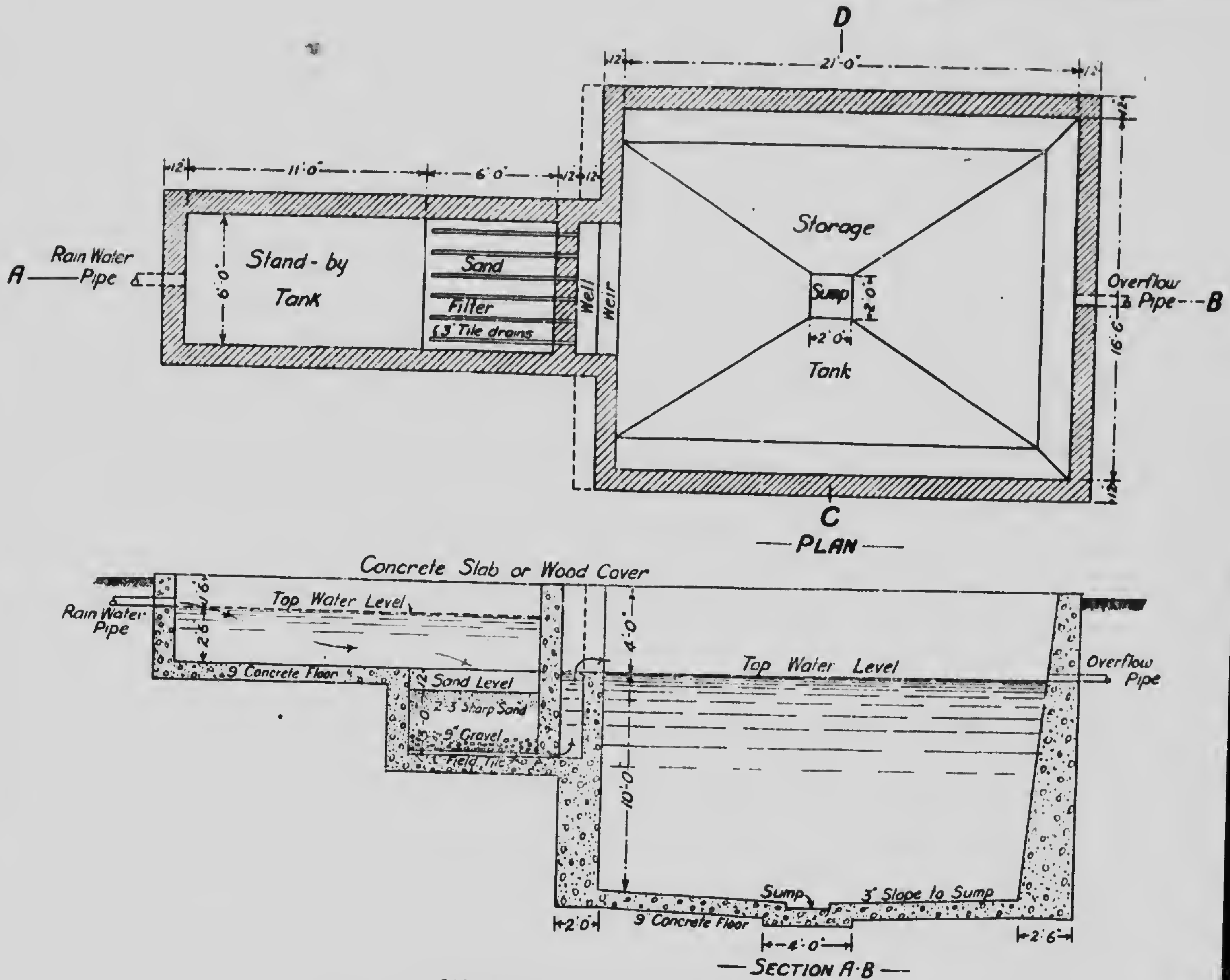
Weed.

The average crop of wheat will evaporate through transpiration about 260 tons of water an acre in the growing season."



SAVING RAIN WATER FROM ROOFS

Plan for filtering and storing rain water referred to in Dr. Seymour's address.

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WATER CONSUMED BY CROPS AND WEEDS

Mr. A. S. Dawson, Chief Engineer of the Department of Natural Resources of the Canadian Pacific Railway, contributed a lengthy paper discussing various aspects of water supply, from which these interesting remarks are given.

"The site of a spring or the presence of a stream determined the first settlements of savage men; and his civilized descendents have continued to be more or less dependent on like conditions. Reliable information regarding water supply is one of the first things a prospective settler makes enquiry of; as it is of paramount importance to him to know the character and quantity of the water in any district—the average depths of the wells, the probable cost of sinking such, and the character of the strata. Such information should be provided properly tabulated, and made available for reference by some branch of the federal or provincial governments."

"Section 10 of the Irrigation Act provides that applications for water shall have precedence in the following order:

1. Domestic Supply — Meaning water for household and sanitary purposes, and all purposes connected with the watering of stock, and the working of agricultural machinery by steam.

2. Municipal Purposes — Meaning water for household and sanitary purposes, the watering of animals, streets, walks, boulevards, lawns and gardens; fire protection; the flushing of sewers; and the water which is necessary in the construction of buildings and civic works; and other purposes usually served by water within a town or village.

3. Industrial Purposes — Meaning the working of railways or factories by steam.

4. Irrigation Purposes.

5. Other Purposes.

Each of these subdivisions represents a broad subject; and each one is made the life study of men along the lines of chemical, geological, and engineering research. The subjects as a whole are of intense importance to every city, town and rural community in the province, and of vital interest to every individual be he a resident of the cities or of the farms. It is closely interwoven with the health of the individuals as well as with the agricultural and live stock developments of the country as a whole. There is no question which confronts the southern half of the province today on which action along co-operative lines is more necessary and essential, than that of water. This of course does not relieve any one of individual effort; but co-operation is absolutely essential; and the assistance of large corporations as well as the different branches of both provincial and federal governments should be along the broadest possible lines—such as through contour surveys, borings and reservoir construction."

"A growth of weeds in a crop or on summerfallow represents a tremendous loss of moisture; 1,000 pounds per acre of the most efficient weeds representing a loss of at least 1½ inches of stored rainfall, or from 4 to 5 inches of stored rainfall in the case of the weeds having a high water requirement. These latter figures represent about the maximum amount of moisture that can be stored in fallow land.

The following is a summary of water requirements determined at Akron, Colo., in 1911-1912 and 1913 based on the production of dry matter: Tumble Weed and Pig Weed, 287; Russian Thistle, 336; Corn, 368; Sugar Beets, 397; Wheat, 513; Barley, 534; Oats, 597; Mountain Sage, 616; Cabbage, 640; Spring Rye, 685; Sweet Clover, 770; Field Peas, 788; Ordinary Clover, 797; Alfalfa, 830; Brome Grass, 861; Flax, 905; Rag Weed, 948.

In other words Flax required twice as much water as Wheat to produce a pound of dry matter. Brome Grass 2½ times as much as Sugar Beets. Sage 2½ times as much as Tumble Weed.

The average crop of wheat will evaporate through transpiration about 260 tons of water an acre in the growing season."

WATER SUPPLY AND AGRICULTURAL EDUCATION

The Connections Between Them

Address by E. A. Howes, Dean of the Faculty of Agriculture, University of Alberta.

It is with particular pleasure that I respond to the offer of a few minutes in which to address those who have gathered at this conference. I have been interested in Lethbridge ever since I first visited Alberta at the time of the Dry Farming congress. I thought then there must be some live people about this vicinity and I have had no reason to alter my opinion since then. I have a pleasant recollection of the time I spoke in this city on the subject of agricultural education. The night was intensely cold; there was a fancy dress carnival billed for that date, not to speak of a theatrical company visiting Lethbridge for that night only. Despite these attractions we had a crowded hall, and there were as many city people present as there were people from the country. Upon investigation I found that the explanation lay in the fact that in this district the city interests were and are hooked up with the country interests and the interdependence has resulted in greater efficiency and consequently greater achievement. As a result of that interdependence, I take it, we have the present conference.

I have asked to have the subject assigned to me somewhat enlarged, not to secure more floor time, but in order to submit a scheme as a whole; so instead of dealing with the relationship of the College of Agriculture to the question of water supply I have requested the privilege of being allowed to speak briefly upon the attitude of that institution toward the whole subject of agricultural engineering.

It would appear that there are three great departments of agricultural engineering that are of paramount importance to the province of Alberta, and I might comment briefly upon each at this stage of the discussion. I refer to the departments of roadmaking, irrigation and drainage.

Roadmaking—It has been said, and with some justification, that the only good road makers in this country were Providence and the Indians and both left the roads alone. Especially in the north has it been the case within the last few years that some of the so-called road improvements have been fearfully and wonderfully made, and we hear the wish often expressed that the present day occupiers would also leave the trails alone. However as one trail after another is cut off by the two strands of wire strung upon more or less dependable posts, we are brought face to face with the problem since we must make our paths straight, of how we shall accomplish this in a way to achieve the greatest possible satisfaction. Good roads must always be considered from the standpoint of pleasure, but by the farming communities they must also be seriously considered from the standpoint of economy. Some have figured that in normal times it costs more per bushel to haul the grain from the farm to the elevator than it costs per bushel to convey the grain the remainder of the way to Europe. Be that as it may, I feel certain that the exact relation between these two costs, if an average could be accurately struck, would give us material for serious consideration. We have a large problem in securing good roads for the agricultural communities in Alberta.

Irrigation—It is scarcely necessary for me to dilate upon the importance of irrigation in a portion of Alberta when speaking before such a meeting as this. There is a part of our province that is made up of land that should be irrigated and an additional portion where irrigation facilities should be provided as an insurance factor. The question of water supply, with its kindred problem of water application in a way to achieve best results, is of outstanding importance to a great number of our farmers.

Drainage—This department is of interest to almost every part of Alberta. We cannot consider the problem of irrigation in its entirety without taking cognizance of the part that drainage must play in the plan. This has not always been done in this province nor has it always been attended to in older irrigated lands. I know of land in Nevada that has been under irrigation ever since the first years of the gold rush, land which was supposed to be capable of handling its own drainage requirements, but where today the increasing signs of alkali serve notice that the question of artificial drainage can be no longer ignored. Then we have the problems of surface drainage and underdrainage in areas which must sooner or later be reclaimed for agricultural purposes. This may range from the task of draining some small slough to a large proposition such as is now contemplated in the Haysland district. We really have done little drainage work so far and only such as has been forced upon us, but we have the large problem before us and we should prepare ourselves to handle it.

Now as to the relation of the College of Agriculture at the university to these three departments of agricultural engineering; it seems to me that we have a two-fold duty to perform. In the first place we must see that our students are graduated with a course that shall put themselves in a position to be of service to the province. I do not mean that a man who secures his B.S.A. must also be an engineer in the sense now popularly accepted. I do claim, however, that a comprehensive course in engineering can be made a part of his degree work and that he can thus be put in a position to handle very many of the problems he meets. I submit that a thorough grounding in soils and crops, to speak of the related subjects of physics, chemistry and bacteriology is essential to the proper application of agricultural engineering principles. He should, if possible, spend two summers between college years with survey parties to round out the instruction he receives in engineering principles during the college terms. Our students, in this as in any other specialty should be thoroughly practical but this should be the result of the study of sound theory. Practice without foundational theory is but a sorry makeshift.

The second field of service for the college is in the realm of research. In the three departments I have just outlined what a vast field for experiment we have before us. The soil problem and the crop problems, not to speak of the mechanical problems, are very far from being solved in this new province of ours. We are scarcely well started and there should be a great field for usefulness on the part of the university, and I do not hesitate to say that just as soon as we can handle the matter we hope to put it upon a good working basis. But this takes men and money and both are hard to procure these days. Moreover there is opinion to shape. I mean that funds can only be forthcoming when the people desiring the service organize to ask for that service. We are ready to add to our staff and to undertake training and research work just as soon as we have the means to do so. I must now leave the question of support to the consideration of this convention.

HOLDING SURFACE WATER BY DAMS

Address by E. Ainsworth, Inspector of Public Works.

Up to the present very little has been done by the provincial government by way of constructing dams in coulees to form reservoirs for storing water to be used by farmers for watering stock. During the dry seasons prior to 1915, there was considerable talk among the farmers who had intentions of raising the fills across coulees along road allowances and making the fill form a purpose of raising the roadway and forming a reservoir. One dam was built on this plan along the road allowance between sections 33 and 34, township 10, range 22, west of the fourth. The department of public works gave a grant of money while the farmers gave a like amount in construction work. A second site for a dam was surveyed on section 28-11-19-4, but to date no work has been done.

Around Raymond Mr. Knight has constructed several large dams for private purposes. These have been located in most instances on roadways. Then, throughout Southern Alberta, the farmers have numerous dams in coulees which in ordinary years, hold water enough to supply their stock the year round. In dry years these small reservoirs usually dry up.

Dams, for forming reservoirs, should never be constructed along the road allowances. Three reasons for this may be cited:

1. Stock allowed to stand around the water soon makes it filthy.
2. They tear down grades and often obstruct the roadway.
3. If a washout should occur in the dam the roadway is obstructed.

The department has found it the better plan to keep separate dams for reservoirs and grades for roadways.

A few points might be noted for guidance to those who contemplate constructing reservoirs.

1. Bore down in the ground in the bottom of the coulee and make sure the soil is not of a sand or gravel formation. Should this be the case, water would soon seep away.
2. If the drainage is not sufficiently large to fill the reservoir in ordinary seasons, snow fences can be built to cause snow to fill the depression in connection with reservoir, which will melt. Rains will not then be depended upon to replenish the store of water, and a fresh supply may be had in the spring of the year when the water is getting low and poor in quality.
3. Gophers will sometimes dig through the dam, which if entirely constructed of clay, will allow the water to seep through and often wash outs will occur. To prevent this, the back wall of the dam should be covered with sand. When the gophers dig, the sand caves in and the gophers will take no chances of being buried.
4. A dam is less liable to give way if constructed like an arch with the convex side against the water. Then the centre of the dam should be the highest. If the spillway will not carry all the water, the overflow will have to go around the ends of the dam where the earth is solid, and wash outs are not liable to occur.
5. The spillway should be placed at one end of the dam and cut through solid earth. Rocks should be used to prevent the soil from washing away as the water runs back into the coulee.
6. Rocks should be used in rip rapping that part of the bank which will be washed by the water in the reservoir. The amount of riprapping necessary will be determined by the amount of water stored. For example, a small body of water would perhaps require no riprapping, as the wind would not be able to raise waves of any size, while on a large body, waves would be started by small gusts of wind.
7. Before starting the foundation of a dam, it will be well to plow the ground. This will allow the soil used in constructing the dam to amalgamate with the base or ground on which the dam is being constructed. Seepage will thus be prevented.
8. A narrow deep reservoir is better than a wide shallow one. Not so much surface will be allowed for evaporation. In this high altitude this is a point that should be given particular attention.
9. The face of the dam upon which the water lies should be flat enough that the stones used for riprapping will not slide to the bottom of the

slope. A slope of two or three feet horizontal to one foot vertical would suffice, depending upon the nature of the earth in use and the height of the dam. One and one-half feet horizontal to one vertical is sufficient for the lower slope.

Fortunately in Southern Alberta the soil is clay loam and holds water very well, but where the soil is of a sandy nature there will be considerable percolation through the dam unless some means of preventing this is adopted. The usual method is to dig a trench, deep enough to reach an impervious foundation, along the centre of the dam site. This trench is then filled with a puddle clay, and carried up through the dam as high as the water surface. In some instances, it will require more than one of these puddle walls.

DISCUSSIONS ON MR. AINSWORTH'S PAPER

MR. PETERS:

Surface Waters

Attention must be drawn to the fact that all surface water in Alberta and Saskatchewan belongs to the Dominion government. A riparian owner is entitled to the use of all the water he requires for domestic purposes, but he has no right to build a dam to store the water or build any works for the diversion of the water without authorization from the Government. This means that any man building waters must first apply to the Commissioner of Irrigation at Calgary.

The Irrigation Branch employs engineers who are familiar with the farmer's problems and are ready and glad whenever an application is submitted, to give a farmer all the details he requires about how to build a dam, etc., or advise him on any point at all that may come up whenever they are able.

Dams in Small Streams and Coulees

These will very often form the cheapest and best source of water supply, particularly for stock. For household use the water may have to be filtered or treated with some cheap chemical to make the water safe.

Quantity of Water

The first big question, particularly on a small draw or coulee is how much water is there available. This depends mainly on the drainage above but also very largely on the slope of the land and the kind of soil. For example, steep slopes with heavy clay soil will run off nearly all the snow or rainfall, while with flat land and sandy soil very little water runs off. It is very difficult to give any ready rules, but the farmer by using common sense and noting the spring runs can generally make a fairly good estimate. Then by choosing the reservoir site and fixing the height of the dam there can be stored either the whole available supply or else the quantity the farmer requires to [illegible] him through the longest period of drought which occurs in the locality. In figuring on the storage required, one must add together the quantity to be used, the quantity lost by evaporation and the quantity lost by seepage.

Each farmer will know best what water he actually requires for use but as a general rule, reckoning the average family and the average amount of stock on a quarter section about 400 gallons per day will be enough.

An open reservoir will lose about two feet in depth during the year from evaporation. The evaporation will be decreased to a considerable extent by planting a tree belt all round the reservoir in order to break the wind and give shade. Around a reservoir is an excellent place to get a good growth of trees where irrigation is not available on other parts of the farm.

The reservoir may lose a very large quantity by seepage, depending upon the kind of soil. In some of the heavy clay soils there is practically no seepage, while in a gravelly soil it is impossible to hold water without some kind of lining. The following may be taken as general rules for absorption losses (evaporation plus seepage). The depths are reckoned on the average covered by water. Thus if the reservoir full covers three acres, and nearly empty in the fall, covers one acre, the absorption would be reckoned on the average area of two acres. Clay or heavy clay loam, three inches per month; loam, five inches per month; sandy soil or light sandy loam, eight inches per month; very sandy or gravelly, twelve inches per month.

For a reservoir in a creek bottom it is well to cut and burn off all brush so that this will not rot and contaminate the water. But do not disturb the sod as this makes a tighter bottom than the loose sod. If the creek bottom is gravelly it will leak out water and this can be stopped by hauling in clay and covering it with puddle. Reservoirs in a creek will tend to get tighter with age as silt drops to the bottom and creates a fairly good lining. If there is an ample supply of water in the creek it will be cheaper to make the dam higher and figure on losing water by seepage than to try and stop it. For a reservoir in a coulee where the supply is very limited or where the made reservoir is filled from an irrigation ditch, one cannot afford to lose water by seepage and the reservoir must be lined.

Concrete makes the best lining but in Alberta, owing to the heavy frosts heaving the lining, the expense would be very heavy.

Asphalt is cheaper and has been used, but gets very hard in winter and would also suffer from frost. When oil is found in commercial quantities in Alberta, crude oil may prove a good cheap method of treating a reservoir to make it tight. At the present time the lining recommended for farmers' use is a clay puddle. The puddle should be at least six inches thick and, to ensure it being of an even thickness, the reservoir bottom and sides should be carefully smoothed before the puddle is put on. The best puddle is heavy gravelly clay. Pure clay is much improved by mixing in some fine gravel with sharp sand in it. This mixing may be done by first spreading the clay over the bottom and sides of the reservoir and then putting on a layer of gravel, say a quarter as thick as the clay. This will get mixed in during the puddling process. The clay must be kept wet while it is being puddled. The best way to do the puddling is by tramping the clay all over by stock with small hoofs, sheep, hogs, cattle and horses are the best in the order mentioned. The clay must be thoroughly tramped all over to make a good puddle. The best way is to drive a herd of sheep all over it and keep doing this until the lining is all thoroughly tramped down. Some people recommend putting a temporary fence and keeping and feeding the stock in the reservoir until they have it all well puddled. A reservoir built in moderately tight clay can be improved by puddling the bottom and sides as described above. If the clay lining gets dried out and cracked at any time it must be puddled again to make it tight. The next question is how big does the stream get during the biggest floods. Remember that nearly all dams are washed out by the big floods although they may only last a short time. It is rare that a reservoir is big enough to hold all the water that may come down and the dam must be built to convey the biggest flood over it or else build a spillway to carry the biggest flood around it. The spillway is the best plan and the wider it is the better. The safety of the dam depends on the spillway, so always build this very wide. It is a good rule to make the spillway about twice as big as you think it ought to be.

Design of the Dam

Dams may be built in many different ways, but the commonest and cheapest form on the prairie is the earth dam. The work that the dam has to do is to hold up the water, so it must be strong and tight against leakage.

A low dam built of average earth will be amply strong with a top width of six feet, a slope on the water side of three to one, and on the dry side a slope of 1 and a half to one. The elevation of the spillway will control the high water level in the dam and one must always build the dam two or three feet higher than high water level. If the wind has a clear sweep down the reservoir the dam must be high enough so that the waves will not lap over the top. The wave action will tend to eat away the water face of the dam and to stop this the dam must be riprapped. Large stones carefully laid so that the waves will not wash them out are best. If stones are not available then make a covering of brush or straw. Brush can be held in place by stout stakes at about eight feet apart and strong wires between. Straw is held down by stout stakes and chicken netting between. A combination of both may be most suitable, straw with a light covering of brush and then stakes and wire. Sometimes a fence is built to stop the brush, made of solid boards or perhaps of wire and brush, like the old wire corrals.

The dam is most likely to leak just where it joins the ground. To stop this and make a good bond, plough the ground the dam is going to sit on and scrape all the sod away. Do not put any sods in the dam—they make leaks. Sometimes to make a better bond a trench is dug across the length of the dam and filled up as the dam is built. In building the dam, walk the horses on the dam as much as possible, this makes the dam much stronger and tighter. Do not excavate the earth inside the reservoir any closer than 10 feet to the edge of the dam.

Do not excavate any earth in the bottom of the draw or coulee close to the outside edge of the dam—take it from the sides higher up.

Dugouts

This is the local name for a reservoir that is made by excavating—not by building a dam and backing up the water. If there is a good depth of solid clay, the dugout is perhaps the best because you lose less water by evaporation and seepage. In every case of storing water the greater depth you have the better—it saves loss by evaporation and seepage and the water does not freeze to the bottom in winter. A very good combination is to build a dam creating a reservoir and have a dugout in the bottom of the reservoir. The excavation from the dugout builds the dam and it is not much harder to excavate out of one place and make the dugout than to borrow from places a little closer and not work down quite so deep. The Government of Saskatchewan have built a great many of these combination reservoirs and dugouts in connection with their road work. In the dry territory whenever they have a road grade crossing a coulee, they excavate a dugout to build the grade, which in turn forms a dam, the culvert taking the place of a spillway. The following are brief notes on these government dugouts, which I may say have proved of the greatest value and convenience to the farmers in our sister province.

The dugouts are found of many different types, according to local conditions, but they are all constructed and located along the following general principles. For location they occur in (1) dry districts; (2) impervious soils; (3) natural drainage courses; (4) on or near road allowances, and maintain their efficiency under the following rules of construction: (1) maximum depth of water; (2) a minimum surface area; (3) fencing against pollution; (4) appliances for taking water.

In classes they may be considered under the heads of: (1) dugouts for the development of springs; (2) reservoirs in deep coulees; (3) combination dugouts and reservoirs in shallow coulees; (4) dugouts in dry slough beds; (5) dugouts in open prairie.

The most efficient and desired source of supply is, of course, the developed spring, where replenishment is constant, and means of protection against pollution can be readily installed. The latter is usually accomplished by boxing in the head of the supply, and equipping it with pumps, then, by excavating a dugout in the overflow basin for stock watering purposes.

The next in efficiency is the dam and reservoir, constructed in deep coulees (say up to fifty feet), where the supply is more readily replenished from the larger drainage basin, or watershed, and the reservoir is better protected from hot winds, etc. But they are of the most expensive type, due largely to the protection for the dam, in passing the overflow water. Greatest consideration should always be given to the spillway capacity, and its strength to resist spring and other freshets. Spillways should never be constructed in the centre of earth dams but rather at the side in natural ground, care being taken to head the water away from the earth work entirely. Dams in shallow coulees are usually easy to construct, and easy to approach, but they very often require dugouts in the bottom to get depth and keep down vegetable growth.

Dugouts in dry slough beds are not desirable as the water collected in them is very strong in vegetable matter, and high in color. They, however, retain the water and are less subject to soakage.

Dugouts in the open prairie are only constructed in emergency cases, but they are usually very efficient, and retain their water in good condition. Replenishment however is very slow and they generally depend on the winter snow and early spring rains for their supply. In size they are usually 200 feet long, 50 feet wide and from 10 to 15 feet deep, holding approximately 700,000 imperial gallons.

By MR DAWSON:

In connection with the matter of surface and top widths. From practical experience I would say that 4 to 1 is more preferable than 3 to 1 as Mr. Peters suggests. It admits of the rip-rap being placed to better advantage. The dry slope can be made 2 to 1 for many reasons. It is not possible to build a dam 6 feet in width for practical purposes. I can recommend that nothing less than 1 in 4 and 2 to 1 at the rear side and nothing less than from 6 to 8 feet at top is practical. The matter of freeboard is one of much importance

By MR FAIRFIELD:

Could I just take a moment to emphasize this particular point that Mr. Peters has just mentioned. During the last two winters, particularly when we have had very hard and cold weather, the farmers in the district, hereabout, have been suffering a good deal from the fact that storage reservoirs have frozen down to the bottom. Mr. Peters has explained how this could be overcome by making a combined dugout and reservoir. The average farmer does not recognize the necessity for making the bottom deep enough. It is only during a very short period that the ice forms clear to the bottom. In your small reservoirs it would not be necessary to make them large, make the burrow 3, 4 or 5 feet deep. That would mean 12 feet of water, even though the reservoir would freeze over. I think that farmers would do well to let their reservoirs dry out this summer and dig a pit in them.

By MR. PETERS:

All water in this province belongs to the government. All persons who desire to build a dam should apply to the government for permission to do so. Farmers have thought when they had a small coulee on their own land it was ridiculous to apply to the Dominion Government for permission to build a dam on their own property when the water is in the coulees. When we give you a water right we assume the responsibility of protecting it for you. It may be that the coulee which supplies your farm runs also through another man's land before reaching you, and some day he may put in a dam and cut off your supply. If you have a license then the Dominion Government will protect you in that respect.

PLANT GROWTH MAY INDICATE PRESENCE OF WATER

During the Conference, Mr. S. S. Dunham, vice-president of the United Farmers of Alberta, said:

Is there any surface indication of any kind as to the presence of water? In riding over this country and observing more or less closely, I happened to notice in two or three districts that where it was known water could be found within eight or ten feet, I noticed what we call a sand burr. Evidently the burr must go to water. I do not know if there is anything in it.

It looks like the ordinary copper burr only it is thinner and lank and grows about a foot high. It is very abundant just north of Taber where they get water within eight or ten feet of it.

Mr. Stewart of Sutfield, said:

On the C.P.R. land adjoining mine, a man there went down 253 feet and 175 feet. They have not water yet. At another place he went down 25 feet and in another 75 feet. He found a water weed. He took a team and scraper and went down and found the place where the water weed was growing. He then took a common post hole auger and went down another 6 or 7 feet and found water, then taking the scraper and going right down. I have 75 head of cattle and my father-in-law has 50 head, and they and the owner's stock all water there, and there is plenty of it. This is the only water in the district. This water weed looks like an onion.

Mr. Harris:

This gentleman has seen probably the same water weed as I have seen. It looks like an onion and has a head something like asparagus.

The chairman said:

This opens up some interesting possibilities and it ought to be looked into. I will ask Mr. J. F. Irwin, (who is in charge of the various illustration plots throughout this Province, the purpose of which is to carry out on a farmer's own land and by his own effort, some of the work that has been demonstrated to be successful at the Experimental Farms of the Dominion) and Mr. F. C. Nunnick, of the Commission of Conservation to look into this matter; and we shall hope to hear from them further regarding this in due course.

WESTERN RAILROADS AND THEIR WATER SUPPLIES

(Address by E. L. LANDORPH, C.P.R. Engineering Department, Winnipeg.)

In order to provide a railway with water for operating purposes it is practically always considered profitable to incur in fairly heavy expenditures in order to bring water of suitable quality and of sufficient quantity to the track at the points where it is wanted. This is done by means of pumping plants, reservoirs and wells at the source of supply and pipe lines to the road tanks. The cost of these installations will naturally increase the fixed charges of the road.

A railway will not haul water in water cars except as a last resource or as a temporary measure, as the hauling of water in cars is costly and in the winter time even a difficult undertaking, besides it encumbers the trains with dead tonnage, where revenue bearing freight could be hauled instead of the water.

It has generally been the practice in preference to locate the water stations at some stream, even if a considerable reservoir has to be constructed in order to conserve water for fall and winter use. Much more satisfactory is a reliable supply of suitable ground water, as the yield is fairly constant throughout the year, the water filtered by nature and free of organic growth. Springs and wells yielding enough water to supply a railway company with sufficient water to meet the demand at terminals or even at bigger way-stations are rarely found. In locations where any such powerful springs with suitable water are found within a reasonable distance from the railway location, a well has to be dug in order to find the quantity of the yield.

The public does not perhaps realize what enormous quantities of water a railway requires even at a smaller station, and I should like to mention just a few facts in this connection to show how powerful a well or spring has to be before it can be developed and operated by a railway with any degree of success. At a smaller terminal point as Lethbridge the Canadian Pacific railway requires about 375,000 gallons of water per day for roundhouse service and dispatching of locomotives and coaches, a larger terminal like Moose Jaw uses close on twice that amount, the average water station on the main line requires 150,000 gallons per day, and even on the smaller branch lines a water supply is not considered reliable unless it will produce 20,000 gallons of water during each working day, that is ten hours.

It would be interesting to know why a spring keeps flowing all the year, in spite of that the rain might fall on its drainage area for only a few months. The reason for this is to be found in the slow rate of speed of ground waters as compared with surface waters. The permeability and porosity of the water bearing strata vary greatly. Some rock will have a high porosity and still the permeability for water will be slight, as the smallness of the pores cause capillary attraction. In lime stone regions where the water passes through the fissures in the rock, springs are liable to cease after a prolonged period of dry weather. The speed of water in gravel and sand strata is so small that the yield of the springs becomes almost constant throughout the year, and most springs in such strata will never dry up.

In prospecting the engineer follows up the waterbearing strata, until he finds the point which is the closest to the place where the water is to be used. This may be done by auger borings so as to determine the strata and follow the underground stream.

Another method is divining. The C.P.R. has done very little divining work. As far as my knowledge goes, this method has been tried out only a few times and with very embarrassing results; in most instances the water was of unsuitable quality or of unsatisfactory quantity, if found undoubtedly to a large extent due to the special purpose for which the water was to be used. Far be it from me to throw any shadow upon the fine art of finding water as I have seen and heard a deal of it, but more interesting to me are the water findings by means of a mechanical device as undertaken by some well drilling contractors in Saskatchewan.

The device is known as the Mansfield Water-finder and may not be the only machine invented for the purpose of finding water, although I do not know of any other. It detects the water by means of a magnetic needle, which is being influenced on by the electric or magnetic field, which surrounds the running water in the underground rivers and brooks. The device has been found to be around 85 per cent. efficient, providing that it is used on suitable days, as surface evaporation, rain or snow, and spring run-off tend to spoil the indications.

Taking all these things into consideration the device is not 85 per cent. efficient as claimed by the manufacturers. A clear day with few clouds is the best day to go water divining, and even then it takes men of ability and considerable experience to handle it. I do not wish to say more in regard to this.

At some points where it has been found necessary to try to intercept all the water running in an underground river, dams of sheet-piling have been driven across the stream and down below the water bearing strata. A great example of this kind is to be found at the plant, where the city of Moose Jaw gets it present water supply. I think it would probably be advisable to try this method in the old river bottoms, but you must have the sheet piling dams and holes on the up stream side.

The first C. P. R. well in this area was drilled at Foremost in 1914, 724 feet deep; water was met first at 622 feet below the surface, and was only four inches in diameter at the bottom. It gave a flow of barely 7,000 gallons per day of extremely soft, sodic and slightly carburetted water. The yield of the well has not been satisfactory for a railway station, and the flow has been on a decrease, like numerous other artesian wells; most likely the water carrying fissures are gradually getting obstructed with minute particles. It has not been thought advisable to dynamite the bottom of the well for fear of spoiling the supply entirely, and a new eight inch well will be drilled in the near future. The water is not the very best for locomotive use, in spite of its softness, it contains 7½ lbs. of sodium salts per 1000 gallons, this causes the water to foam very badly in the boilers. Such water is generally known as "light" water. An interesting feature about the Foremost water is the total absence of sodium sulphate.

The C.P.R has this year prospected for deep well water at Burdett, Alberta. Here water was found in a thick gravel bed about 230 feet below the surface. The water at Burdett contains nearly 3½ lbs. of scale forming salts and 13 lbs. of sodium salts in solution per 1000 gallons, and is therefore not good boiler water. The water cannot be termed soft, but it contains enough soda and epsom salt in solution to make it appear soft. In this respect it resembles nearly all the deep well waters in use on the C.P.R.

In other parts of Alberta and Saskatchewan the C.P.R. drilled numerous holes for deep well water supplies, with varying success; the Kerrobert-Coronation line, around Carstairs and Irricana along the Aldersyde subdivision between Brant and Kirkcaldy, at various points between Empress and Swift Current and on the Portal sub-division southeast of Moose Jaw. With a few exceptions these waters are all fairly soft, but they contain a large quantity of sodium salts in solution, at times so much that the water could not possibly be used for steaming purposes. The waters from the deep wells at Abbey and Sceptre are conspicuously different from the other deep well waters as used on the C.P.R. as they contain very little sodium salt in solution, are very hard and have a corrosive effect on the boilers. The Abbey water is even sulphuretted.

The C.P.R. does not as a rule use their own water for drinking, in coaches and station, but depend on the water which the company purchases from the various towns and cities. Therefore very few sanitary analysis have ever been made by the company. The waters are analysed just to determine the suitability for steaming purposes. This comprises the general description of the water with regard to turbidity, color, odor and taste, the determination of the temporary and permanent hardness, amount of sodium salts, silica, alumina and iron present in solution, also the amount of organic matters present.

When it comes to using water for drinking purposes, the definition of a pure and wholesome water is different from the one that would be used by the engineer about water for industrial use. I do not wish to go into details of sanitary bacteriological and chemical examination of drinking water, but would say that if I were given the choice between the scientific examination of water for drinking purposes and a sanitary survey of the surrounding of the source of the supply of the same water, in order to decide whether the water was safe or not, I shall want to make the sanitary survey in preference. The examination of the water itself will show if the water is contaminated or even infected, but the survey will show why this is the case, and how to remedy. Running surface waters and waters in open reservoirs are mostly contaminated to some extent, they may also be infected by disease spreading bacteria or poisoned by lead or dye-stuffs. Standing waters are mostly always befouled by an amount of organic matter, and are therefore rarely safe waters. Wells and springs produce safe waters in a far higher percentage than surface water supplies.

Anybody using wells should see that animal and human waste, fecals and garbage are disposed of in such a way they they will not contaminate the well waters. He should locate his well a suitable distance from stables and outhouses and he should close the mouth of his well as far the greatest amount of pollution will enter the well from the top.

DISCUSSION

Mr. Claydon to Mr. Landorph:

I believe you are speaking on behalf of the C.P.R. Is it a fact that the C.P.R. hired a man to locate with a willow?

Yes.

Was that man successful?

No.

Mr. Crawford asks whether the water diviner's needle is affected by the possible proximity of the machine to iron and steel farm implements.

Mr. Landorph:

I am sure it will not have any effect on it. Even the magnetism of the earth has little or no effect.

Mr. Charlesworth. asked re the machine which the department has:

The machine that the department has is a Mansfield.

All last season we had a man looking for water with this machine testing it out, and it was loaned to a Mr. Isaac in Nobleford. The department is willing to lend the machine to farmers who are proposing immediately to drill. I believe only six wells were drilled last year. Reports showed that four of these found water. The machine was sent away and has just been returned, and it is proposed to send it out again. We want to get records of every spot that is drilled. We have been told that the machine is not very satisfactory, and that it requires a good deal of expert handling.

Mr. B. S. Smith, Farm Superintendent of the Development Branch of C.P.R.:

My department has to do with the improved farms which the C.P.R. handle. We had a Mansfield machine but it has not been used for some time, our tests not being successful. In my opinion the only way to find water is to drill for it. The machine is unsatisfactory. They claim you must not use it on a cloudy day and yet you must not have the sun shining on the machine. I had a man going to England for a holiday and he called on the makers and spent about a week with them learning how to operate the machine. He came back to Alberta and spent about three months trying to use the machine, without any success whatever. On one occasion he took an umbrella with him. The day was very bright, no clouds to mention and he rigged the umbrella up so as to shade the machine when he was testing. Nothing came of it, and I wrote to the makers telling them of the fact. They immediately picked up the fact that the man had an umbrella with him and that therefore it must have been a dull day, and possibly raining.

Mr. Claydon:

If you will lend me this machine I will guarantee to find water with it, and if you want security for it I will mortgage my homestead for it.

Mr. Smith:

With the consent of my superiors I will be only too glad to let you have the machine.

PROSPECT FOR WATER SUPPLY BY PERCOLATION FROM FURTHER IRRIGATION DEVELOPMENT

(By F. H. PETERS, Commissioner of Irrigation.)

All underground waters as well as all surface waters have their original source in the clouds. From the clouds the water falls on the ground somewhere and immediately tries to work its way downward to sea level, in this vicinity a distance of about 3,000 feet, by seeping directly into the ground or leaking out from the bottom of coulees, creeks or rivers. Underground waters or well supplies all come from this common source. They are formed by the water working downwards until it reaches some impervious strata of clay or rock where it cannot sink any further, and so it spreads out forming an underground reservoir, or flows slowly along over the impervious strata.

We have the waters falling down from the clouds mainly in the mountains and the foot hills at the higher elevations, and always fighting to run down to gain sea level. Because the earth is more or less tight most of the water is forced out into the small coulees and streams; the streams run into the rivers and the rivers run to the sea, always tending to get down into the ground. Thus the main sources from which water can leak into the ground, that is the rivers are usually cut deep into the ground by the time they get out to the prairies, keeping it always near the top of the ground. These ditches lose a great deal of water by leakage which tends to form an underground source of supply much higher up than the waters leaking out of the rivers themselves. Thus any large irrigation development must tend to raise the ground water level much higher than would occur in nature with the water leaking only out of the rivers.

In order to get down to some definite figures to show what may occur, we will discuss in some detail the area which is tributary to Lethbridge, as the big distributing centre. This territory would be bounded on the north by a line running northeast through Monarch, until it reaches the Little Bow river, thence down the Little Bow and Oldman rivers; on the south by Milk river ridge and Milk river itself; on the east by a line through Bow Island and Pakowki lake, on the west by the Blood Indian Reserve.

The total area of this tract is about 2½ million acres. The A. R. & I. development covers about 390,000 acres or 15% of the whole. When the proposed Lethbridge Northern project and the Milk and St. Mary rivers project are completed, together with the present A. R. & I. tract, there will be about 520,000 acres irrigable which represents 20% of the total area. When the tract is fully developed and the water is being used this would apply over the whole area a gross quantity of water equal to 882,000 acre feet, and all of this water would be kept by the irrigation supply ditches high up on the ground. I have reckoned that about one-sixth of the water actually applied by irrigators on the field will be lost by deep percolation below the plant roots, and adding to this the quantity of water which it has been estimated will actually leak out of the canals, it shows that there will be 362,000 acre feet of water annually distributed over this whole area near the surface which will either sink into the ground or work its way out to the coulees and run off as surface water. Supposing this quantity of water seeped out evenly over the total area under discussion which contains approximately 16,000 quarter sections of land, it would make available on each quarter section 17,000 imperial gallons per day for the whole year.

The water of course, will not spread out evenly and it is not to be expected that any of the figures above give a general idea of the possibilities for the improvement of ground water supplies, but there is no doubt that any large irrigation development of this kind will much improve underground well water conditions.

I do not know whether there is any shallow impervious strata which is likely to catch this water and hold it up closely to the surface of the ground, and I would particularly like to have some discussion on this, probably from Mr. Dowling or some of the other geologists.

It is understood that a special enquiry has been made as regards the water supply conditions in the neck of land in the bend of the Oldman river, west of Lethbridge. Under the proposed Lethbridge Northern project there is a canal which passes half a mile west of Coalhurst, and then runs almost due south for about seven miles, keeping at an average distance of probably one and a half miles from the cut banks of the river, forming the east boundary of the plateau. The whole of this plateau is approximately 390 feet above the river on both sides of it, and naturally as it is thus cut off it is not to be expected that any underground water would be found above the level of the river water. The total area in this plateau south of Coalhurst is about 18,000 acres, and of this it is proposed to irrigate 3,370 acres, or about 19%. The land on the westerly side of the plateau rises probably from 25 to 50 feet above the elevation of the irrigation canal and if there was an underground strata having a slope to the west the seepage water from the canal system might well provide well water supply at a shallow distance. In any event the canal would not be further than three miles from any point in the area described.

Speaking of the tract in general, waste water is very often available from any large irrigation system, and usually enough water will be wasted out of the system, and by the irrigators, to create a sufficient supply of domestic water in all the coulees and water channels which drain the area. It must be remembered, however, that whatever water is supplied to the tract belongs first to the farmer, who have water rights under the irrigation system, and when the very dry periods occur this is just the time that they use the most of the water, and so any people dwelling along the water courses cannot rely on having the water just as they want it, but must take it as it comes and make the best of it.

The two great drainage channels for the proposed development east of Lethbridge, would be Chin coulee and Etzikom coulee. Water finding its way into Chin coulee would eventually run down just north of Foremost and finally find its way into Seven-persons river and run down to Medicine Hat. The length of this course which we might expect to find with running water in it after the system is fully developed and measured from the A. R. & I. Chin reservoir, down to Medicine Hat, is about 100 miles. The length of Etzikom coulee from Stirling down to Pakowki lake is about 70 miles.

Following Etzikom coulee leads one to think of Pakowki lake, which I understand means "Bad Water lake." Some people have dreamed that this might some day be turned into a "good water lake"—and it requires no argument to show what a great boon it would be to the country lying to the east of Lethbridge, if this great lake could be turned into a reasonably good source of fresh water supply. Perhaps this dream may some day come true, and so I will set before you some facts in regard to it. Pakowki lake is lower than Milk river where Milk river nearly runs into it at the present time, as it very probably did in times past. While I have no definite figures to consult, a flood water canal from Milk river into Pakowki lake would probably be about 4¼ miles long, and for about 3 miles of this length the cutting would be about 14 feet deep. When the development of the irrigation extension is undertaken one of the essential features will be the repair of the A. R. & I. company's Milk river canal to utilize the waters out of Milk river. If this work was undertaken as the first link to be constructed in the final development it would probably be the best way of filling Pakowki lake. The work required would be to build a new low intake dam, do some repair work on the old canal, and build an extension ca[illegible] for 25 miles. This would run the [illegible] from Milk river into Kipp coulee n[illegible] Stirling and thence down Etzikom coulee into Pakowki lake. From the point of view of domestic and stock water supply only this development would create a living stream of water over 100 miles long right through the dry country in addition to filling up the lake the features of which are noted below. Eventually, when the Canadian irrigation development is completed, there will be practically no water available out of Milk river to turn directly into Pakowki lake. At the present time, however, there is enough natural drainage into this basin to just about keep it wet over the bottom, and if we could utilize the waters which are now going to waste to once fill the lake up ten or fifteen feet deep. It is very likely that after the irrigation development has been fully completed there would be enough waste water from the system, together with the natural drainage, to maintain the lake at a good level. According to the township maps, this lake has a length of shore line equal to 68 miles, and an area of 26,231 acres. If the lake were filled with water there would be 160 quarter sections abutting directly on the shores of the lake, and with the road allowances that would run into the lake the supply from it could easily be extended to cover a margin of 2 or 3 miles around the lake, either by hauling water with carts or by sinking wells to reach down into the ground water level which would extend out from the lake.

DISCUSSION

Mr. D. B. Dowling made the following comments on the above:

A considerable part of the land over which this project has started is underlaid by a sand-bed. Consequently the water seepage would be down some distance. I would like to explain that the beds are dipping towards the west so that the loss would be away from your area. Here at Lethbridge you are down very nearly at the foot of the hill. You come down here to the black shale. This black shale area is in a few places along the river, that area running south to the Milk river ridge. The rock underneath that bed has got the Lethbridge coal shale in it. Then you have about 600 feet of sand beds. There may be some places in these sand beds that would stop water, but at 600 feet down you come to the Taber coal seam. As you go east and follow this you find that the beds commence to go thin, comparatively. We know that in tracing out some of the coal in the Taber seam we found it not very far under the surface. We have coal seams over at Grassy lake just eighty feet under the town. As one goes east it commences to dip again, and we find beds that will let a lot of water pass through. There may be also beds that will hold this water, and under this again there is three hundred feet of a little more impervious bed. The water from the surface could not get below 350 feet anyway. There would be a possibility that you would get water from these lower depths.

DRILLING BY THE JETTING PROCESS

Mr Howard E Simpson Assistant State Geologist of North Dakota sent the following telegram to the Conference: "Trust Conference will result in improved water supply for great prairie plains which provide the bread for reunited Canada, America and Motherland North Dakota pledges itself for fraternal co-operation."

Mr. Simpson contributes the following memorandum regarding the jetting process of drilling:

"As I have been engaged for several years in a study of the underground water problems in North Dakota, and before that in Iowa for the U S Geological Survey, I have some appreciation of the problem which is confronting you

"Regarding the cheap process of drilling small holes developed in North Dakota, I may say that you probably refer to the jetting process which is in almost universal use for farm wells in this state. This is a very rapid and inexpensive method, and therefore a very useful one in soft materials.

"In the jetting method the material is both loosened and carried to the surface by water under pressure. The water enters the well through a small pipe and forced downwards through the drill bit in jets against the bottom of the hole. The material thus loosened is carried to the surface by the return stream of water between the rod and the walls of the well or the casing as in the hydraulic rotary method, during drilling the drill pipe is turned slowly to insure a straight hole and to enable the small bit used to puddle the material so that it can be easily removed.

"The casing usually sinks of its own weight or is driven as fast as drilling proceeds. In clayey material the hole may be jetted down without casing as the walls are puddled with sludge. The hard layers may be penetrated by the use of the bit as in percussion methods, but this is too light for very hard layers and a string of solid tools similar to those of the portable standard are generally carried for this work by the best rigs.

"The first jetting outfit was built by W. C. Wells in 1884. It is now much employed on the Atlantic Coastal Plain and in the alluvial valleys of the arid west In southeastern California it has been very successful in sinking wells for artesian water There 4 inch wells, 400 to 500 feet in depth are not uncommonly sunk, curbed and cleaned in two days

"The jetting process is the prevailing process in North Dakota because of the soft unconsolidated character of the shales and sands that constitute the chief bed rock formations of the region. The jetting method is well adapted for soft incoherent materials, capable of being broken up with the water jet, particularly for sand carrying considerable water and not capable of standing alone. It is a rapid and cheap method and the supplies required are inexpensive and easily obtainable. It may therefore be operated continuously It is limited to wells of moderate depth and small diameter in soft materials. It requires a previous supply of water cannot utilize small seaps, but instead plasters up small water seams and utilized but one water bed, which must be a fairly strong one.

"It has been found very satisfactory for wells two to four inches in diameter to depths of 500 feet. For larger holes and greater depths I think the portable standard rig perferable, and for holes of 1500 feet or more I would advise a standard derrick, because of the need of starting with a large hole and therefore with large tools."

On the same subject, Mr. J. R. Chalmers, Secretary, North Dakota Well Drillers' Association wrote as follows:

Your enquiry relating to a cheap process of drilling small holes for farm well water supplies at hand, replying will say that the process which I think you would have in mind is termed the jetting process, and is obtained by equipping the drilling machine with one or two power pumps as desired, and attaching a heavy discharge hose from the pumps to a water swivel, thence to hollow drill and drill rods, the size of which depends wholly on the size hole desired.

I will say, however, the success of this process depends largely upon the different formations one would encounter in sinking the hole, if the formations were from ninety-five to one hundred per cent dirt, then this process would in my judgment work the more satisfactory, and again should one encounter quicksand, then this either in the rotary jet or percussion jet, is the only process that will work satisfactory.

In the territory I am familiar with which by the way covers the entire State of North Dakota in my work as Secretary of the North Dakota Well Drillers' Association, at least eighty per cent. I will say, of the drilling machines are equipped with the jetting process, and these machines are sinking wells of two, three and four inches in diameter, and in the south eastern part of the State they are sinking the Artesian wells to a depth of 2000 feet with this process.

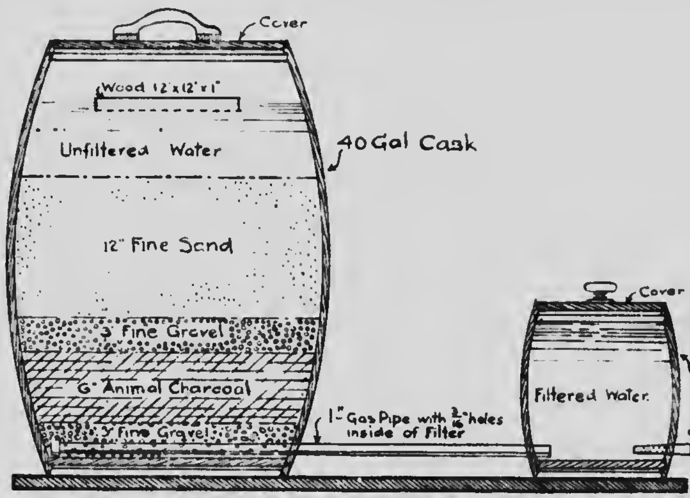
In my immediate territory I am using this process exclusively and with very satisfactory results, yet am not in a vicinity that this process is best adapted to. If you are in the Glacial Drift territory, I can recommend this process as the best.

PURIFYING WATER ON THE FARM

(By F. H. Peters, Commissioner of Irrigation for the Dominion of Canada)

Water Still for Farm Use

The general proposition to consider in this connection is that many, many farmers have the greatest difficulty in getting water that is pure and nice to drink. Every one of these farmers has a stove in his kitchen, which in addition to cooking his food and so on at least in the summer when drinking water is mostly required, makes the kitchen hot and uncomfortable. By utilizing this excess heat to distil water one is killing two birds with one stone, and certainly when the proper method of distilling water for drinking purposes is worked out it will be a great practical benefit. I think it is not looking too far ahead to reckon that before long some of the manufacturers in the East will design a stove particularly for use on the dry prairies, which will have a water jacket all over the top of it, which would boil water every time the stove is lighted, the steam from which could be conducted into a condenser put near to the stove, and thus use up all the excess heat to provide good drinking water. Without going so far as this, it is probable that if one could get in touch with the right people, that water stills to sit on top of a kitchen stove can be obtained ready made for probably about $25.00 each which will distil perhaps up to two quarts per hour. The still shown was made by a tinsmith and may prove useful to some farmers until a better one is found. Any one who would like to have one of these stills constructed may send a request to the Commissioner of Irrigation at Calgary, and a set of plans and photographs will be sent, which I think will enable one to have a similar still built by any local tinsmith.



WATER FILTER FOR FARM USE (Illustration from "Farmer's Advocate")

The still as it exists, cost $12.00 to make and this tinsmith stated that if he got a number of orders, he could make the succeeding ones for less money, probably $10.00, unless the price of materials advanced very much in the meantime. When this still was built, the price of all materials had risen a great deal on account of the war, and at ordinary times there would be no difficulty in getting a still constructed for $10.00. The still has been tested out with a moderate fire, and will turn out easily a quart of water each hour. The water in the cooler has to be changed occasionally but can be left there until it is sufficiently hot to be drawn off and used for washing dishes and other similar purposes. The still shown has two lengths of pipe attached, but the longer the pipe is, the better the still will work. The only precaution that is necessary is to give the pipe a slight fall from the steamer down to the still so that any water condensed in the pipe will run down into the distilled water chamber. If no slope is given to the pipe it will probably leak on the kitchen floor. It is presumed that there will be no objection to the size of the condensing can, because this can be put away in a corner where it is not a nuisance, but if the steamer which has to go on the stove is found to be awkward by taking up too much room, I think that this could be reduced in size without effecting the efficiency of the still at all. I also think that the steamer could be improved by having a copper bottom made so that it would sink through the stove hole, say an inch, and thus get much more heat from the fire. Distilled water has a very dead taste and it can be much improved by aeration. This can be done in a ready way by pouring the water from one vessel to another through a sieve so as to introduce air.

Methods of Filtering Water

I am going to make this heading broad enough to cover in a general way home made methods that may be adopted to make bad water safe and pleasant for drinking.

Boiling is probably the simplest and safest method of treating all bad water. If the water is boiled for ten minutes it will kill practically every germ that is likely to be found in any water in this country, and in addition the boiling will precipitate a great deal of the lime and other mineral salts out of the water. If the boiled water tastes dead it can be improved by aerating as suggested for the distilled water.

Another easy way to treat water that will kill all the germs and make it safe for drinking, is by the addition of some chemical. The safest chemical and the easiest to handle is chlorine and the easiest form to handle it in is the ordinary chloride of lime or bleaching powder. The chloride of lime rapidly deteriorates with age, dampness, etc., and to get good results buy a package that looks new and fresh and then keep it in a tin can with a tight top. The dose recommended for making water quite safe is 25 grains to 100 gallons of water. For a rough rule you can add half a teaspoon smoothed off level to a 10 gallon barrel of water. This is more than the proper amount quoted above, but so long as it does not make the water taste it cannot hurt you. In order to get the chlorine well mixed up in the water, dissolve the powder in half a pail full of water and then pour into the barrel and stir it around a little. This method was used by irrigation survey camps when operating in districts where the water supply was doubtful, and when we were hauling water in tanks. When the driver went out for the water we supplied him with the proper dose of chloride of lime to add to the tank. As soon as he had filled the tank then he used to dissolve this dose in two buckets of water and pour it into the tank, then by the time he got back to camp it was thoroughly well mixed up from the jolting along the road and the water was safe to drink. The men at first complained a little bit of the taste, but after a while got so that they would not drink anything else.

I think that some form of filtration is the best for the farmer to adopt as an all round method of getting water that is pleasant to drink and also fairly well cleared of all dangerous bacteria, and for any farmer who has water piped into his house and can get a pressure from a tap, there are many patented filters sold that are very efficient, and the best thing he can do is to get one of these. Where there are no taps to attach a filter to one has to adopt a simple gravel form of filter, and while I am not familiar with these filters as sold by the trade, I have no doubt that some good ones are made and could be procured by local hardware men. I am inserting a little drawing and note hereunder showing how you can make a home-made filter that should give excellent results in clarifying any water and will also take out most of the bacteria. If you are using this filter, however, and there ever happens to be a little epidemic of typhoid or something of this sort in the neighborhood, treat your water with the chlorine before you filter it, in order to make sure that your children will be quite safe in drinking the water. The sketch on page 42 shows the filter made out of two barrels with about the proper depths of charcoal and sand. The thicker the charcoal and sand is, the better. If you find the filter works too slowly you may remove some of the sand, and if it works too quickly add some more sand. The filter could be made equally well by using two galvanized iron cans with a pipe connection between, instead of the barrels.

Starting at the bottom of the filter we have a one-inch gas pipe perforated with 3-16 inch holes, to let the water in evenly from the gravel. This is covered with fine gravel to keep the charcoal from washing through the pipe. The charcoal must be broken up and rammed tight. The charcoal in turn is covered with fine gravel to keep the sand out of it, and on top of this gravel is placed the laery of fine sharp sand. You keep a piece of board lying on top of the sand so that when you pour the water in, it will splash on top of this instead of digging a hole in the sand.

The sand takes most of the mud out of the water and so after a time the top will get dirty and make the filter very slow. When this happens, skim off the top inch of sand and give the next foot a good stirring and loosen it up a little. The charcoal oxidizes and purifies the water and is probably the most important feature of the filter. The charcoal must be animal charcoal, which really consists of burnt bones. This is much better than wood charcoal. The ordinary druggist probably does not stock any quantity of animal charcoal, but should be able to procure it on short notice and sell it for not more than 25 cents a pound.

At the end of the season, or if it becomes necessary sooner, take the sand and charcoal out, give them a good washing and then dry them in the sun, and after this they are good for another season. Be careful to put in clean material and in starting the filter or after you have stirred the sand up let the first water run to waste, because it will have some dirt in it.

FARM WATER SUPPLY SURVEY

By F. C. Nunnick, B.S.A., Agriculturist of the Commission of Conservation

During, and since the year 1910 agricultural surveys have been conducted by the Commission of Conservation in various parts of Canada. One portion of the survey dealt with the question of the water supply on farms. The work during 1910-12 was conducted near Stavely and Namao in Alberta near Indian Head and Saskatoon in Saskatchewan and near Hamiota, Carberry and Morden in Manitoba. In 1913-14 the districts of Camrose, Innisfall and DeWinton in Alberta; Yorkton, Melfort and Kindersley in Saskatchewan, and Pilot Mound, Gilbert Plains and Souris in Manitoba were also visited. Approximately 100 farms were visited in each province in each survey. The survey was conducted in all the provinces of the country but I have only taken the particulars for the western provinces.

The survey consisted, largely, of a diagnosis of existing conditions on farms in regard to the water supply and took into consideration source of supply, distance from buildings and sources of contamination, methods of conveying water to house, home conveniences and other such matters.

The following are extracts from the reports sent in by the collectors:

ALBERTA

Namao

"The water supply is a serious problem, nearly all the shallow wells are saline and leave a very limited supply of water. Many of the farmers get their drinking supply by melting ice obtained from the Saskatchewan or the Sturgeon rivers in winter and haul it in some cases over eight miles. A number of drilled wells giving a good supply of water exist."

Stavely

"Wells supply practically all the water used in the district and most of these wells are drilled. A few dug shallow wells, are still used but in most of these the supply of water is very limited and the water is rather hard and often 'alkali.' The deep drilled wells are said to have good soft water. Some of them are nearly 200 feet deep but the average is about 100 feet. A few of them are flowing wells."

De Winton

"As a general rule the water in this district is good although an occasional well is found which is tainted with alkali. It is often somewhat difficult to get a supply of water and the wells are usually dug where the indications of a supply are good without any regard as to the convenience to the house or barn. A great many of the wells are drilled and of considerable depth so that the danger of infection with surface impurities is reduced to a minimum. Still some shallow wells are located a short distance from the stables or on an incline where the seepage from the barnyard has access to them."

Innisfail

Conditions were found to be similar to De Winton.

Camrose

"The water here is inclined to be slightly alkaline, but there is an abundance for stock purposes in creeks, lakes and sloughs.

As at De Winton, and in fact in every other part of the west, the wells are located primarily where there is a likelihood of a supply, although sometimes inconvenient for the buildings."

SASKATCHEWAN

Indian Head

"The water supply is not always satisfactory. It is in some cases very difficult to get even in deep wells and often when obtained is found to be alkaline. Some are fortunate in securing water of good quality at, or near, the buildings. Generally speaking, insufficient thought has been given to the relation of the water supply to possible carriers of disease, such as the water closet and out buildings. In some cases the drainage from the latter is not away from, but toward the water supply. The aim has been to get water at any cost, and the question of possible contam tuation has in some cases been partly overlooked in the search for the difficult obtainable water. The sewage from the town of Indian Head is poured into one of the ravines after more or less imperfect filtering and is causing some dissatisfaction to the people who take water from the stream or from shallow wells beside it below the town."

Yorkton

"Yorkton district has abundant supplies of water within easy distances from the surfaces. The wells are close to the buildings, only three farmers having to haul water. Practically all wells had good pumps installed in them. In a few instances the house wells were close enough to the stables or closets to be in danger of being contaminated by them."

Melfort

"The question of house water is a very serious one in this district. There is no difficulty in getting a supply of water but it is so alkali it cannot be used for cooking and drinking. Of the farms visited 75 per cent. used rain water for cooking and drinking, some had granolithic roofs on their houses and large tanks in the basement, others simply had the shingle roofs and tanks in the open, some of them not having covers. Fifty per cent. of them put up supplies of ice and used it for drinking or for cooling the rain water. In some three or four instances people were using water from a creek close by which received the drainage from the stables. Some four out of the thirty-two farms inspected had bath rooms in the house. In some cases the water closets were placed too close to the houses."

Kindersley

"The water supply on the majority of the farms is very poor. Some have to haul all water used on the farm, others have lots of water but it is so strong in minerals that it cannot be used in the house. On many of the farms that have water the wells are a long distance from the buildings, and while this perhaps is fine from a sanitary point of view, it makes extra work."

While none here may doubt the existence of a water problem in Western Canada, the foregoing extracts serve to point out its seriousness, and to show how general is the trouble. Difficulties exist in parts of all the prairie provinces. We find that it is difficult in some parts to even obtain water, and where it is obtained it is sometimes unfit for domestic use.

We have seen that the majority of farmers visited obtain water from wells for house use and for the stock. While I have not time to discuss the sanitary aspect of the farm water supply, I desire to emphasize the fact that the purity of the water for health's sake is as important as the abundance of supply for the sake of comfort and convenience. Dr. Jas. W. Robertson has well said: "Water in the house, to use lavishly for all wholesome conveniences, seems at first thought beyond the means of frugal people, who have earned by hard labor all they have to spend. It looks to some, who have not closely considered the costs and the benefits, like an extravagance. Instead of that it is one of the greatest of house economies. Almost every farmer could afford the luxury of all water conveniences in his home. These are real luxuries, like their fellows, sunshine, wholesome food and fresh air which do not weaken the muscular, mental or moral fibres of life. When one has been compelled to use any of these, debased for a time, how satisfying is the pleasure of purity and abundance.

"As an investment for the home I know of nothing likely to yield so much in return in saving women's strength, in increasing house comforts, in preserving health, in imparting satisfaction in housework and in elevating the general tone of the material side of living."

Attention must be paid to keeping the source of the water supply free from contamination. The drinking of impure water has the effect of depressing the vitality of the whole family, making them more liable to disease and resulting in loss of efficiency. These are evils in addition to the occasional cases of fever which come from drinking well water into which the seepage from house or stables has found its way. This will, no doubt, be dealt with by those discussing sanitation.

Once there is an abundance of pure water obtained on the farm there is no single improvement which will bring so much comfort to the household as some mechanical arrangement to make the supply readily available and convenient to use.

I have often wondered why a farmer would pay $150 for an implement that he would use only a few days and which would stand idle the rest of the year, and would not pay the same to instal a home waterworks system and conveniences which would be used 365 days in the year and enjoyed by every member of the family. There are many ways by which the water can be placed on tap in the house. The windmill or the gas engine will pump it to either an overhead tank or to a pneumatic tank located anywhere on the premises.

There are two requirements necessary on every farm or in every home, one for work and one for living. Too often the equipment for work receives the major portion of attention. Why should we not put first things first?

RESOLUTIONS BY THE CONFERENCE

The resolutions passed during the conference, which sum up very well the trend of the discussions and the objects it was endeavored to arrive at, follow:

The Resolutions.

"That this conference respectfully requests that full inquiry be made by the department of the interior of the Dominion government into the important question of reservations along the rivers, lake and coulee fronts for sanctuary for live stock in time of drought in the drier areas in Southern Alberta and Southern Saskatchewan, with a view to making such reservations.

"Further that, following upon and during this inquiry, the Alberta and Saskatchewan provincial governments collaborate with the Dominion to the end that practicable road approaches may be provided for reaching those reserves;

"And further, that the government take steps to reserve a strip along all water fronts."

"Resolved that this conference respectfully requests the Dominion government department of the Interior, to make inquiry with a view to supplying a living stream of water from Milk river, via the A.R. & I. irrigation canals, via Stirling and Etzikom coulee and Pakowki lake, with a view to constructing such works as may be necessary to supply such water for the increasing needs of the farming communities of Southern Alberta;

"That in the opinion of this conference there should be established at the University of Alberta a department of agricultural engineering to give the B.S.A. graduates and others interested a course in this work, and to undertake such research work as shall be of service to the farmers of Alberta in matters pertaining to road making, irrigation and drainage."

Test Wells

"In view of the information given at this conference that the irrigation branch of the department of the Interior have a Calyx boring machine which could be used for rapidly and cheaply drilling test holes for the discovery of water. Resolved that this conference respectfully requests the Alberta government to secure the use of this machine for discovery tests, first in the area south of Coalhurst and west of Lethbridge, and if it is found satisfactory in practice for this purpose that the Alberta government purchase several of these machines for use in testing for water in depths up to 100 feet.

"Resolved that this conference urges on both the Dominion and provincial governments the desirability of obtaining a full and complete log of all wells dug or drilled whether for water, gas or oil in Canada. That such information is absolutely necessary having in view location of further wells;

"That analysis of water so obtained in such wells be recorded for purposes of ascertaining if such be potable or suitable for stock watering purposes;

"That if in order to obtain such laws legislation be necessary, that the same be passed; also that regulations be passed to prevent waste of waters from flowing water wells and gas and oil wells."

REVIEW OF THE BENEFITS TO BE DERIVED FROM THE WATER CONFERENCE

"I am very well satisfied with the whole of the proceedings at the water conference yesterday," said President Marnoch of the Board of Trade to the Lethbridge Herald. "That does not mean that I think all the farms that have not got water supplies today will get plenty of water this week or next week; for when you remember that yesterday's meeting was just a stock-taking of what has taken three and a half years to arrive at, you see that patience and perseverence are the watchwords."

As far as securing water supplies is concerned there are three ways: 1, Catching and Holding; 2, Finding; 3, Leading.

Catching and Holding Water.

As to catching and holding, I think many farmers have not given enough attention to catching and holding water from the roofs of their buildings. I am sorry that most of the farmers who came to the conference had to get home to do the chores, and were unable to hear Dr. Seymour's excellent and practical hints on this subject last night; but I understand the "Herald" will print extracts from his address that will be helpful. The doctor kindly offered to send a bulletin on this subject, "Conservation of rain water" to anyone who would write to the Public Health Department of Saskatchewan at Regina. Under this heading, too, it was mentioned by several of the speakers that reservoirs in this country where there is quick evaporation should be made narrow and deep and not broad and shallow.

Finding Water

As to the second, finding water. That is necessarily slower. Mr. Dowling has been working at this for two years past, and he has put before us valuable information as to the field for artesian water. But there is not so much information available as we want about underground water nearer to the surface. I hope that it may be arranged that we can get several of these small boring machines made available for discovery of water at depths down to a hundred feet or so. The use of these in certain districts, with the results of the borings carefully recorded, will do more for us than a whole host of water diviners.

Leading the Water

Then as to leading the water, Mr Peters showed us what irrigation ditches would do in this direction, and in course of the discussion of some of his remarks it became clear that a sum of money comparatively small in relation to the benefits that would be derived, would be sufficient to carry a big volume of water from the Milk river up by Stirling into the Etzikom coulee and so into the Pakowki lake, that would provide a stream of living water through a very large district. Besides what could be got from this by direct approach, there would no doubt be seepages to the sides that would help well water supplies. Similar benefits will come when the Lethbridge Northern Irrigation project is gone on with, as we hope it will be, after the war.

Reservations Along Water Fronts

One other source of supply that we hope may be taken care of is the reservations that the conference requested that there should be made along the rivers, lakes and coulees. If the provincial government will join hands with the Dominion on some plan whereby the Dominion will keep the lands in reserve and the province will acquire road approaches to them, we shall be one other step nearer to the solution of part of this big water problem.

General Benefits

Not the least benefit that will come from the conference is the acquaintance that the men of science made with each other. The geologists, the engineers and the public health men, and the agriculturists met each other, and each gained something from the other that will greatly help southern Saskatchewan and southern Alberta. The farmers met with these gentlemen, too, and were very well satisfied that they are all heartily interested in giving them the very best service that they can.

IMPORTANCE OF WATER SUPPLY

(Editorial in the Farmers' Advocate.)

"We are not giving away any secrets when we say that through the southern and middle section of Saskatchewan and Alberta the lack of satisfactory water supplies for the house and for live stock is a very serious drawback, not only affecting the profitableness of the farm, but making the farm life less pleasant and attractive.

"We know farms established for thirty years that draw water for house and stock at times as far as twelve miles. It also seems a peculiar coincidence that it is over much of the best land where it is impossible to secure wells that will yield water at all or water of a quality fit for use in the home.

"For years large sums of money have been spent by farmers in an indiscriminate manner in sinking holes in the ground in these areas to no avail. They still draw the water in tanks for use for house and sometimes for stock.

"In some districts this water scarcity has been overcome by digging out reservoirs and by damming ravines, but there has been up to the present no concrete or unified action to meet this condition.

"The water convention, held recently in Lethbridge, and brought together through the work of G. R. Marnoch, president of the Lethbridge Board of Trade, is the first effort towards systematizing research work in respect to securing water supplies in these waterless districts and gathering together what data is already known. Through the efforts of Mr. Marnoch there already has been a partial government geological survey of Southern Alberta to determine where water is likely to be secured and at what depths. Such a survey should be extended through the whole of Western Canada covering those areas where water is scarce. Such a survey would save farmers huge sums that are spent in boring dry holes down hundreds of feet.

"Where it is impossible to secure well water of a satisfactory quality what is to be done? In such districts there should be a systematic work carried on toward conserving and storing up surface water in reservoirs made by doms in ravines or through excavating. This will give water for stock and, by suitable filtration, for the home also. Tanks should also be built to conserve rain water from buildings. The quantity of water that can be stored up in this manner from the rain falling on house and barn is no small item and must be taken into consideration.

"Chief of all the factors, though, to be considered in water supply for the farm house is its purity. We know somewhat of the sickness that is caused by drinking impure water, particularly in relation to typhoid fever. This means that where surface water is used it must be purified. Filtration is the usual method. Filtration is effective with a proper filtering plant, but it may easily get out of order. The surest method of purifying the water is by distillation. While there are, as far as we know, no distillation plants on the market for farm home use, the construction of such a plant is very simple and, following the facts brought out at the convention at Lethbridge, there will likely be greater interest in this mannner of purifying water for the home, and manufacture of water stills will follow.

"To satisfactorily meet the situation there is required co-operative work between government, federal, provincial, and municipal, and also with and among farmers in these dry areas. Then we can begin to look for a measure of solution. In the meantime credit is due to the Lethbridge Board of Trade and its president for getting propaganda work under way."

BIBLIOGRAPHY

"The Southern Plains of Alberta," by D. B. Dowling, Geological Survey, Ottawa.

"Summary Report 1915": Geological Survey, Department of Mines, Ottawa.

"Summary Report 1916": Geological Survey, Department of Mines, Ottawa.

"The Farm Well": Exhibition Circular No. 34, Department of Agriculture, Ottawa.

"Conservation of Rain Water": Bulletin No. 14, Bureau of Public Health, Regina, Sask.

"Farm Water Supply and Sanitation" Course XVII: College of Agriculture, State University, Columbus, Ohio.

"Sewage Disposal for Country Homes": College of Agriculture, Cornell University, Ithaca, N.Y.

"Water Supply of the Farmhouse" Bulletin No. 4: College of Agriculture, Manhattan, Kansas.

"Inexpensive Plumbing for Farm Kitchen" Bulletin No. 3: College of Agriculture, Manhattan, Kansas.

"Farm Efficiency": Xenophon Caverno, Kewanee, Ill.

"Domestic Water Supply on the Farm" Circular No. 66: Experimental Station, Bozeman, Montana.

"Sanitary Watering Places for Horses": Missouri State Board of Agriculture, Columbia, Missouri.

The following can be purchased from Superintendent of Documents, Government Printing Office, Washington, D.C., U.S.A.

"Water Supply and Irrigation Papers" No. 5.

"Underground Waters for Farm Use"; Water Supply Paper No. 255.

"Geology and Underground Waters of South Minnesota": Water Supply Paper No. 256.

"Well-Drilling Methods": Water Supply Paper No. 257.

"Underground Water Papers": Water Supply Paper No. 258.

"Surface Water Supply of the U.S. 1913 Lower Mississippi River Basin": Water Supply Paper No. 357.

"The Divining Rod A [illegible] Water Witching": Water Supply Paper No. 416.

"Comforts and Convenience in Farmer's Home": Year Book Separate No. 634.

"Sewage Disposal on the Farm": Year Book Separate No. 712.

"Water Supply, Plumbing and Sewage Disposal for Country Homes": Bulletin No. 57.

"Good Water for Farm Homes": Public Health Bulletin No. 70.

"Modern Conveniences for the Farm Home": Farmers Bulletin No. 270.

"Earth Fill Dams and Hydraulic Lift Dams": Bulletin No. 219, Part 1.

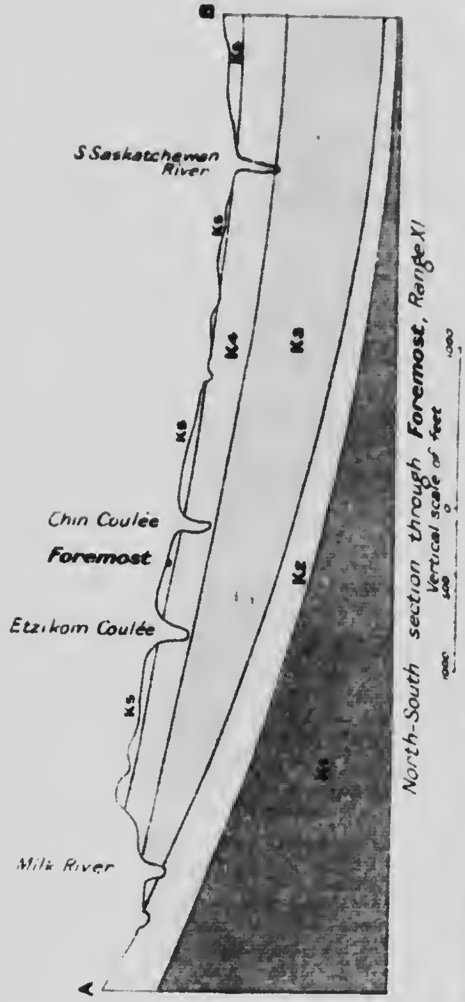
"Timber Dams and Rock Fill Dams": Bulletin No. 249, Part 2.

"Farm Reservoirs": Farmers' Bulletin No. 828.

"A Note on Well Boring": Bulletin No. 68 of 1911, Department of Agriculture, Bombay, India.

"Experiments With Automatic Water Finder": Bulletin No. 72 of 1915, Department of Agriculture, Bombay, India.

INDEX.



Geological Survey Canada

Artesian Water

To accompany Summary Report by D.B. Dowling 19 5

1604

...Water Area. Southern Alberta

Reprint

Miles

Legend

Cretaceous

- St. Mary formation (fresh and brackish water sand and clay)
- K6 Bearpaw shale (marine shale)
- K5 Pale and Yellow beds (mostly fresh water sand and clay)
- K4 Foremost formation (brackish water sand and clay)
- K3 Pakowki shale (marine shale)
- K2 Milk River sandstone (fresh water sand)
- Colorado formation (marine shale)

Belly River series (K5–K2)

Artesian water area

SOME RESULTS FROM THE CONFERENCE

We are receiving inquiries every day from farmers as to what practical results have come from the water conference. As soon as the conference was over, copies of the resolutions were sent on to the Minister of the Interior at Ottawa, and to the Minister of Public Works and the Minister of Agriculture at Edmonton.

There can be no doubt that the closest co-operation will be extended by the Department of the Interior. The Minister writes that, "the matters referring to the Interior Department will be given every consideration, as we desire to do what we can to meet the wishes of our settlers in every reasonable manner consistent with economy during war time."

The Minister of Public Works for Alberta, writes from Edmonton:—

"Anything that we can do to open up road allowances to water reservations will be cheerfully done by us." A formal acknowledgment of receipt of the resolutions has also been received from the Public Works Department at Edmonton.

With regard to the watering reservations for live stock, it will likely take some time to have this thoroughly looked into; but there are many cases now where farmers are blocked from easy access to river waters. Such farmers can now take these matters up direct with the Public Works Department, on the Minister's assurance that road allowances to water will be opened. Farmers can do this individually or through their local organizations.

We are advised that the Minister of the Interior is giving his personal attention to the important subject of stock-watering reservations.

Owing to his duties on the Grain Control Board, Mr. H. W. Wood, President of the United Farmers of Alberta, was unable to attend the conference, but the Board of Directors of the United Farmers of Alberta have placed their official seal of approval on the actions of the conference by the following resolution:—

"Resolved:—

"1. That we endorse the action of the Lethbridge Board of Trade in calling the Water Conference recently held in that city.

"2. That we believe the questions there considered are of vital interest to the farmers generally.

"3. That we are in harmony with the general principle of the resolutions there passed.

"4. That we favour the publication and distribution of the proceedings of the conference at Government expense."

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