Bulletin No. 18 - I. The Reclamation of Arid Lands, II. The Harvey Water Motor

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UNIVERSITY OF WYOMING.
Agricultural College Department.

WYOMING EXPERIMENT STATION,
LARAMIE, WYOMING.

BULLETIN NO. 18.
JUNE, 1894.

I. The Reclamation of Arid Lands.
II. The Harvey Water Motor.

BY THE DIRECTOR.

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Wyoming Agricultural Experiment Station.

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Introduction.

It may be stated as introductory to this bulletin, that back of the agricultural interests and development of the State stands the problem of irrigation laws which effect the control and distribution of the water supply; and back of this irrigation question, also, arises for solution the problem of land laws suited to the conditions of the arid region.

The rapid development of the agricultural resources of the State, therefore, depends upon a wise solution of the problems of irrigation and land laws in the several states. The cultivation of our large and fertile valleys cannot go forward without actual settlers and cultivators of the soil; but before capital and colonies will enter upon the reclamation of these fertile lands, laws must be enacted in harmony with natural conditions which will at least insure the success of the farmer, and a reasonable return upon the capital invested.

Our arable public lands are about exhausted—only the broad prairies of the arid region remain unoccupied—while the demand for homes and small farms is as great as ever in the United States. The problem, therefore, of utilizing the arid lands and developing their resources by irrigation, thrusts itself upon the nation, and especially upon the people of the several arid States.

It is unfortunate that in some localities this question should have been mixed up with politics by partisan individuals. It is not, and cannot be, a political question, because it involves the welfare of all the people in the State without regard to party relations. It seems to be a.
domestic question concerning the people resident in the arid regions; and their judgment and experience will be found essential to a proper solution of the question.

It is the purpose of this bulletin to aid the people in the solution of this problem so vitally related to the future welfare of the State, by giving the facts and collating the principles which enter into its solution. In doing this, we shall endeavor to tersely state the great facts of experience which irrigation in all countries has made prominent, and to suggest to the people of Wyoming the methods and procedure which have proved of value in other localities. We believe that when the people are fully awakened to the importance of this subject, their common sense, expressed through their representatives, will find a happy solution, which will greatly advance the agricultural interests of the State.

The Wyoming Agricultural Experiment Station can never reach its highest efficiency in encouraging and developing the agricultural resources of the State until this problem is solved, and our valleys covered with an industrious class of people devoted to the cultivation of our fertile lands. Therefore, in the issuing of this bulletin, we are endeavoring to get back to the bed-rock principles which enter into the agricultural development of the State.

A. A. J.
The Reclamation of Arid Lands.

A. A. JOHNSON.

BASAL PRINCIPLES OF THE PROBLEM STATED.

The correct solution of this problem depends on sticking to a few fundamental principles, which may be outlined as follows:

1. Every holder of irrigable public land, whether State or United States, should be required to reclaim it or transfer it to someone who will. This principle requires a change in our federal land laws to meet the conditions of the arid regions.

2. We must recognize the fact that all arid lands are not capable of being reclaimed and irrigated. The coming land laws must provide for their disposal and management as grazing lands, and make it possible for the owner of a small irrigated farm to also own some of the grazing lands.

3. Our mountain forests, the home and fountain of our water supply, must be preserved at all hazards.

4. In the arid regions, land and water are one and inseparable. Therefore the land and the water must go together. Owners of land must also own the ditches and canals which make it productive, and owners of ditches must be interested in the land they reclaim. We can never get away from this principle of nature, and be successful. There must be no water monopolies. As our State Engineer puts it: “We want no such vassalage as divided control of land and water creates.”
5. Our State, through our State Engineer and Board of Control, must be continued as the guardians of our water supply, so as to effectively protect the rights of the appropriators, and prevent the waste of our water supply and the wrong use and diversion of our streams. This power of the State ought to be supreme under proper legal restrictions; and the United States land laws should be so amended as to recognize the importance and supreme right of the State to control and appropriate its water supply, as well as to protect its priority of rights on interstate streams.

6. The construction of large irrigation works must be under state control, and according to some pre-arranged plan which will secure the reclamation of the largest body of land at the minimum of cost, due regard always being given to the permanency and durability of the works constructed. The State can easily reach this matter by requiring parties building ditches and canals to secure the approval of the State Engineer as to plans, methods of construction and location, before water rights are granted and right of way across the public lands is allowed. A failure to comply with the plans approved may be made grounds of forfeiture of rights acquired.

These six principles are fundamental, and cannot be ignored without inviting disaster and defeat, and precipitating endless litigation and trouble. These principles recognize the importance and right of the State to reclaim its own arid lands under the sanction and co-operation of the Federal land laws.

PRESENT LAND LAWS.

The past five years have demonstrated the fact that
in Wyoming the present Federal land laws are unfavorable to the reclamation of large bodies of land by irrigation. This grows out of the fact that large and expensive canals are required in order to divert the water of our rivers and get it above these valuable lands.

The Federal land laws are unfavorable to the reclamation of these large bodies of land because they prevent the State from offering inducements to colonists, as well as guaranteeing safety to the capital required. Capital has no protection in the lands reclaimed unless the lands can be speedily colonized so as to secure users of water in sufficient numbers to make the water rentals pay dividends on the capital invested. This is so precarious and uncertain that capital will not venture to undertake such large outlays of money as are required in Wyoming.

It has been demonstrated that colonists are afraid of water monopolies, and are slow to settle on lands where they do not control the water supply needed in their work of reclamation and irrigation. It is an admitted fact that the homestead law does not fit the conditions of the arid regions, and the desert land law is of no value in spreading out our rivers by means of large canals. It has been well said that under these laws “the acreage is too small for the large ditch-builder, and it is too great for the purpose of the actual settler. There is not one immigrant in ten thousand who comes to the arid region to find a home, who has means to reclaim and cultivate 320 acres of land under irrigation, especially in the valleys where expensive canals are required to divert the water from Wyoming streams.”

Thus it happens that large bodies of our most valuable lands are unreclaimed, and our agricultural population
small, because the United States land laws do not fit the conditions of the arid region.

Any one who will investigate the facts will find that the Federal land laws need to be amended in order to encourage the reclamation, settlement and cultivation of the agricultural lands in the arid region.

Wyoming has, in round numbers, 63,000,000 acres of land. Of this amount, at least 10,000,000 acres are suitable for agricultural purposes, much of it exceedingly rich, and lying at a favorable altitude for the successful raising of agricultural products. Of the remaining 53,000,000 acres, there are 22,000,000 acres of mountains, exceedingly valuable because of their minerals, timber, and as the storage basins of our water supply. There are 13,000,000 acres of coal lands in Wyoming, largely undeveloped, thus leaving 18,000,000 acres of high table-lands, suitable only for grazing purposes, very little of which can ever be reclaimed by high-line ditches and canals. The 10,000,000 acres of agricultural lands are fertile, and exceedingly valuable, when considered in their relation to the development of the mineral resources of the state.

METHODS PROPOSED.

The literature upon this subject presents four plans for securing the reclamation of the arid lands, which are now prominently before the country. Two of these plans provide for the exercise of jurisdiction and control over the work by the authorities of the national government; two provide for the exercise of such control by the authorities of the several states. The plans proposed for the prosecution of this work by the national government
are: First, the building of ditches by direct appropriation from the treasury of the United States, the work to be done according to plans provided by government engineers, and under the supervision of government officers. The second of these plans provides for the work being done by private parties, who are given a lien upon the land to be reclaimed as security for the return of money invested in the construction of large canals; but the supervision of the work, the control of the lands, and the control of the water supplies to be under the jurisdiction of the national government. The plans suggested for the prosecution of this work under State control are: First, the preparation of plans and the construction of works by State engineers, and the money to be provided by direct appropriation from the treasury of the State by acts of legislation, or the sale of bonds which the State guarantees and protects by proper legislation. Second, the construction of ditches, canals and reservoirs as private enterprises, but under plans prepared by the State engineer; the parties constructing the canals to be secured in their investment of capital by a lien on the lands reclaimed.

Another plan for carrying out this work has been suggested and discussed by the press of the country, viz.: That Congress should make absolute appropriations or donations for the construction of canals and reservoirs as it makes appropriations for the rivers and harbors. But such a plan has never been advocated in Congress. Many of the best lawyers of the country hold that Congress would have no constitutional right to make such appropriation, and a plan of this nature would no doubt meet with unanimous opposition from other sections of the country.
Another solution proposed for the difficulty is to let the lands remain in the hands of the national government to be administered through our Interior Department under amended Federal Land Laws which meet the conditions of the arid region, and which are based upon the fundamental principles previously stated, the work of the reclamation of the arid lands to be carried forward by an act of Congress by which the proceeds arising from the sale of public lands in the arid regions should be given to the respective states for internal improvements, to be expended and controlled by the authorities of each state. Besides the building of roads and bridges out of this fund, the large amount thus realized by the State could be expended in the construction of large canals and reservoirs which the respective states would own and control as they do the water in the natural streams. This would give to each state a fund out of its own resources to begin the work of reclaiming large bodies of land, the actual farmer and settler to be allowed to attach their laterals to these large canals and reservoirs without expense, and under priority of right to secure the amount of water necessary to irrigate the amount of land which they could successfully cultivate.

The method which has provoked the most discussion and perhaps the greatest popular interest is the ceding of the arid lands to the respective states, so that each state may work out its own destiny under state legislation in dealing with this domestic question (for such it seems to be with all the arid states). This matter has been brought prominently before the people of the United States by the Warren Arid Land Bill, which proposes to cede all the arid lands to the respective states; and by the Carey
The Reclamation of Arid Lands.

Land Bill, which proposes to cede to the states a limited number of acres under conditions which provide for the state's reclamation of the land ceded to the respective states; both of these bills being based upon the fact that reclamation of arid lands is a domestic question which should be relegated to the states interested in this problem.

Mr. Joseph Nimmo, Jr., a special agent of the Department of Agriculture, after making a trip in the study of this question, through Montana, Washington, Idaho, Wyoming and Colorado, reports a decided sentiment in favor of ceding the arid lands to the several states. Mr. Nimmo states that the reasons advanced for the irrigation and ceding of lands of the arid regions are set forth quite fully in memorials to Congress adopted by the legislatures of Wyoming and Idaho. The ground upon which these memorials and the public sentiment appear to rest are as follows:

"(1) The proposition that the irrigable and pastoral lands of the Arid Region should be donated to the states has abundant precedent in the donation of swamp lands to the states, and also of lands for schools, seminaries and agricultural colleges, and for public improvements. These donations of lands have been about as follows:

<table>
<thead>
<tr>
<th>Lands</th>
<th>Acres</th>
</tr>
</thead>
<tbody>
<tr>
<td>Swamp lands</td>
<td>80,200,000</td>
</tr>
<tr>
<td>Lands for schools, seminaries and colleges</td>
<td>78,800,000</td>
</tr>
<tr>
<td>Lands for public improvements</td>
<td>7,800,000</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>166,800,000</strong></td>
</tr>
</tbody>
</table>

"The total area of irrigable land in the Arid Region is estimated at about fifty million acres. Previous estimates which made it over one hundred million acres are now regarded as erroneous. No estimate has been made as to the area of pastoral lands, which are in the aggregate
of much less value than the arable lands will be when irrigated.

"(2) By the terms of the charters of the several Rocky Mountain states, the waters thereof are the property of the State. This was first expressed in the constitution of Colorado, as follows: 'The water of every natural stream not heretofore appropriated, within the State of Colorado, is hereby declared to be the property of the public, and is dedicated to the use of the people of the State.' This is in the nature of an irreversible compact.

"(3) Besides the compact just referred to, the Supreme Court of the United States has declared the right of the states to control the distribution and ownership of water, and Congress has by statutory enactment also recognized this right. (U. S. Rev. Stat. 2339 and 2340). Just here it is proper to observe that throughout the Arid Region values inhere in the water and not in the land.

"(4) The administrative features of the law of appropriation for beneficial uses are peculiar, differing necessarily in the different states, and in different parts of the same state. Privileges which would be applicable to certain streams and in certain localities are not applicable to other streams and in other localities. The enactment of laws which shall meet all these exigencies requires personal and experimental knowledge of the subject of irrigation.

"(5) The administration of the law of appropriation for beneficial uses involves the determination of such questions as the following:

"(a) Questions as to priority of appropriation.

"(b) Questions as to preferences which shall be granted to the use of water for domestic uses, for agricultural uses, and for manufacturing uses, and generally touching the practical application of a doctrine of law upon this particular subject.

"(c) Questions as to the limits which must be placed upon the total area of lands which the waters of particu-
lar streams are sufficient to irrigate, and which such waters can be permitted to serve.

"(d) Questions as to the economic and proper use of water.

"(6) Congress will always be composed very largely of Senators and Representatives familiar with the law of riparian rights, but unfamiliar with the law of appropriation for beneficial uses. This latter law must necessarily prevail in the Arid Region, with all the consequents of that law, vitally affecting the material interests of the people.

"(7) The people of the Arid Region believe that for reasons above stated, Congress will never be able to legislate wisely, or beneficially in regard to the interests of the people.

"(8) To the objection that the power of disposing of the public lands, if conferred upon the States, might be a source of corruption, and an instrument of partisan struggle in the several states, the reply is made that the whole subject will always be open to a general public scrutiny which will operate as a barrier against such prostitution of the power conferred.

"(9) While the United States government retains the ownership of the lands, and disposes of them under the provisions of laws not at all in harmony with the principles which govern development by means of irrigation, there must necessarily arise conflicts between the administration of State and National laws.

"(10) The cost of irrigating works must be realized out of the profits arising from the improvement of the land reclaimed. This is evidently the natural and proper mode of development. In this way the largest results in irrigation have already been achieved. The land laws of the United States not only prevent this, but worse still, so operate as not only to enable but to incite individual land claimants to thwart the plans of companies which are inclined to enter upon large schemes of development, and
to reclaim lands which cannot be reached by private enterprise.

"(11) The memorials of the States of Wyoming and Idaho declare that the progress of those States has been greatly retarded by the fact that corporate capital has not been enabled to engage in the work of building the larger irrigating works, designed to reclaim lands which cannot be reached by individual enterprise.

"The memorial of the State of Wyoming states that 'if the late Territory of Wyoming could, during the past five years, have controlled the disposal of the irrigable lands within its borders, it could, while disposing of it to actual settlers only, have afforded such protection to canal companies as would have given our agriculture four times its present importance and more than doubled our population.'

"The memorial of the State of Idaho embodies this precise language, except that it says ten years where the Wyoming memorial says five years.

"(12) The subject of irrigation is evidently not one which, like the rainfall, can be left to the operation of natural forces, even after the reservoirs and natural ditches are constructed; but it is one which all experience proves must be made the subject of constant governmental supervision and control. Wherever irrigation is practiced, such supervision and control is regarded as a public function. This inheres in the fundamental doctrine of law regarding the subject of irrigation, viz., that the water transported is the property of the public, and that the State must administer the distribution of the public supply.

"(13) It appears to be clear from the foregoing that the regulation of the water supplies of an irrigated district has no analogy in transportation affairs, nor in the ordinary commercial and industrial operations, but must be classed with those industries which, like the coinage of money, the carriage of the mails, public instruction, etc.,
are from the dictates of experience and of reason regarded as absolutely or in certain particulars public functions.

"(14) During the last seventy years the national government has simply acted as the agent and trustee of the people regarding the sale of the public lands, without treating them as a source of national revenue. This is a settled feature of our national policy. It is believed that this agency and trusteeship can now be safely transferred to the States of the Arid Region."

It would seem that this whole problem must be kept in the hands of the people, and worked out under wholesome national and state legislation which shall protect and encourage capital, as well as secure lands for the use of the actual settler who will be induced to come to the arid states because of the success which awaits them through reclaimed lands under the security of wise and equitable laws.

CONCLUSIONS OF THE BRITISH COMMISSION,

On December 23rd, 1884, the British government appointed a royal commission on water supplies and irrigation. It was the duty of this commission to investigate the subject of irrigation in Egypt, Italy, India and the United States, with a view of compiling this information for the guidance of legislation on the subject of irrigation for the province of Victoria. This commission made a special study of irrigation laws, water rights, and methods of constructing large irrigation works in the various countries visited. They have made various progress reports from time to time which have been printed by the British government in Australia. These reports contain much valuable information, and have led to the adoption of the system now practiced in Victoria, which is regarded as
combining the wisdom and best methods on irrigation that can be culled from the practice of the world.

On the subject of irrigation in Italy, the British commission makes the following statement:

"In the first place, it is important to note that almost all the irrigation canals in Piedmont and Lombardy now belong to the State, and the fact is all the more striking when it is remembered that a majority of them were originally constructed by private enterprise. The reason for this change of ownership is not difficult of discovery. As Baird Smith notes, the dangers arising out of monopoly of water, apart from the ownership of the soil, have commended their purchase to the statesman. Both processes, starting out on different principles, have arrived at the same conclusion. The Lombard practice of never separating the water from the land has palpably produced most beneficial results, and, in his judgment, was the chief cause of the rapid multiplication of secondary canals constructed by the private enterprise in that province.

"In Piedmont, the State's proprietary of the water has been almost equally efficacious in encouraging its equitable distribution; but its ownership of the head-works has come to be recognized in each as the best means of insuring justice to the irrigator."

The commission further states that "Italian experience, French experience and Spanish experience all go to show that the interests to be studied in relation to irrigation schemes are so many and so various, and so intimately bound up with the public welfare, that State control is imperatively necessary, and that for the protection of its citizens no monopoly can be permitted which would separate property in water from property in land to which it is to be applied. But at the same time it is established that while a general central control by the State is essential, the business management and distribution of the water is much better placed under the local
authority, as this is more effective in its supervision, more economical in its administration, and is educational, also, in a political sense, to a high degree. The establishment of a comprehensive system of irrigation by private enterprise is possible only under unusual conditions. If it embraces many sources of supply, large areas, or conflicting interests, it is impossible. The capital required is large, the returns are not rapid, and the full benefit secured by the close occupation and complete utilization of considerable areas are so reduced that the State could reach those benefits in unnumbered ways, and settlers are not justified in assuming large responsibilities in their initiation. This becomes palpable when it is perceived that as in Egypt and Italy, carefully matured schemes insure an enormous agricultural production, and the stable prosperity of a large number of producers. It may be safely asserted from foreign experience of many generations that irrigation is one of the soundest national investments, where engineering ability and executive work are expended upon large canals, which are afterwards taken under local control, guided by a carefully compiled code of water laws and regulations, while the land whose production is enhanced is charged with the interest upon the capital expended in supplying it. All of these conditions we ought to possess in Victoria."

In conclusion, the commission makes the following important statement:

"Over and above all differences, and apart from all advantage and disadvantage, there are certain special lessons to be learned, even from a cursory glance at the field of knowledge bearing upon irrigation in Egypt and Italy. In both, the supreme control of the water is vested in the State, and in both the most important works are undertaken by the State, or under its supervision. In both it is demonstrated that no lesser authority can be intrusted with so vital an element of national production. But on the other hand it is found in each country that the State is incapable of satisfactorily discharging the admin-
istrative task of distributing the water to individuals, or undertaking its delivery at convenient times, of supervising its measurement, or the canals by which it is conveyed, or to collect its dues in an inexpensive manner.

"In Egypt the village commune; in France and Spain the association, and in Italy the syndicate, intervene between the State, which owns the water, and the individual who purchases it, while in the first directly and in the last indirectly the State has its advances secured upon the land which is watered. This system is unknown in America; for though state ownership of water is secured in the constitutions of Colorado and Wyoming, there are colonies in California which partake of the communal principle, although the two are not conjoined. There are no State works, but virtually those private persons who construct them do so upon the security of the land benefited. The best American opinion, however, is in favor of such a system of divided responsibility between the settlers and local government, and it has been envied and admired by eminent Indian authorities as well. We are therefore able to claim that the policy adopted in Victoria is in accord with the judgment of those most competent to form an opinion in Europe, Asia and America."

The investigations of this British commission led to the adoption of what may be called the "communal" principle for reclaiming the arid lands of Victoria. Water Trusts are formed somewhat similar to the Irrigation District in California under the Wright Act; but these Water Trusts by law are under governmental control, and can only be carried forward by the sanction of the government, which passes upon the feasibility of the scheme, and also the available water supply for the uses of the proposed Water Trust. The irrigation act of 1886 in Victoria declares the water of all streams to be the property of the Crown, provides for the extinction of any riparian rights that might prevent the use of water for irrigation, author-
izes the construction of national works by the State, and enables Trusts directly elected to carry out their schemes with money advanced from the public treasury. The success of this method of reclaiming the lands in Victoria is shown by the following statement:

"When it is recollected that the first Trusts in the colony were not formed until 1882, and the first Irrigation Trust not until 1884, the progress that has been made may be estimated in a general way from the fact that there are now twenty-four 'Water Trusts' covering an area of 6,300,000 acres, and six Irrigation Trusts covering an area of 356,788 acres, in addition to fifteen applications for the constitution of new Irrigation Trusts which will cover nearly 2,000,000 acres more."

This commission, out of the various facts gathered by investigation, have enunciated several very important principles which have been applied in the solution of the problem of irrigation in Victoria, which are as follows:

"First. In any distribution of water under the authority of the State, owners of the land must be deemed to have a preferential claim on the sources of supply for enough to meet any reasonable domestic requirement and for the watering of stock up to the full carrying capacity of their pastures.

"Second. It is necessary, therefore, that before authority be granted to carry out schemes, and the requisite funds advanced, the government be well assured the proposals are sound, both from an engineering and financial point of view. It is also essential that they should be satisfied that the body of rate-payers on the area on which the cost of the work will fall are agreed as to its necessity, and that the proposed expenditure thereon will be judicious, and the benefits a fair equivalent for the annual charge entailed."

It would seem from the above facts and conclusions of the British commission that they had adopted the Irri-
igation District principle now in vogue in California under what is known as the "Wright Act;" that the communal principle and the irrigation district principle are similar, except that in Victoria the government oversight of the Irrigation Trust is so strong and vigilant as to prevent abuses and failures, which have sprung up, in some instances, under the Irrigation District system of California.

So far as we have proceeded in this matter as a State, we have made no mistake in our legislation. We have observed the fundamental principles which underlie the problem, and are now the admiration of the students of the problem of irrigation in the West. In the State's control of the water with its system of administration, we find that under the laws of 1890-91 provision is made for the formation of Water Divisions for administrative purposes. The Superintendent of each Water Division, who is appointed by the Governor, by and with the consent of the Senate, together with the State Engineer, make up our State Board of Water Control, whose duties are clearly outlined by law. Now it would be an easy step, in harmony with present irrigation laws, to make provision for the creation of Irrigation Districts upon the communal principle of Victoria, with municipal or quasi-municipal powers for the sole purpose of reclaiming land. These Irrigation Districts would vary in size according to locality and the amount of land to be reclaimed from and under the same system of ditches. Our present system of water control would still stand as an excellent method of State control and administration of our water supply, by which all parties would be protected in their priority of water rights, and in the adjudication of disputed claims.

Summed up in a few words, the Irrigation District,
under the statutes of California of 1887, is a municipal corporation, having the same powers to construct irrigation works and to furnish all lands within it water for irrigation, that are possessed by a city or incorporated town to construct water works and to furnish water for its inhabitants for all domestic purposes. These powers are familiar to all and are readily understood.

CONCLUSION.

1. It seems quite clear from all the facts under consideration that if the Federal land laws are to remain unchanged, and the United States is to remain the owner of the large bodies of public lands in the Arid Region, then their reclamation must be undertaken by the national government, for private capital will not enter upon this work under the conditions now prevalent and imposed by the present Federal land laws.

2. While the United States retains control over the public lands in the Arid Region it is impossible for the States to adopt the communal principle of Victoria, or the Irrigation District system of California.

3. It, therefore, follows that the Arid Region of the West must remain undeveloped and uninhabited unless the arid lands are ceded to the respective States, so that each State may work out its own destiny under wise legislation.

We have no desire to advocate any system or method in this Bulletin, but to call attention to the fact that the agricultural resources and possibilities of the Arid Region cannot be fully realized, and utilized, until this irrigation problem is solved by wise National and State legislation.
The Harvey Water Motor.

A NEW INVENTION FOR IRRIGATION PURPOSES.

The Platte River, one of the largest streams in Wyoming, has not been largely utilized for irrigation purposes because of the peculiar topography of the country through which it passes, and because of the great expenses incurred in building canals with sufficient fall to utilize the waters of this stream for the purposes of irrigation.

The peculiarity of its banks has made it difficult to build head-gates, which would enable ranchmen of moderate means to take out the waters of the stream. Only long and high-line canals which cost into the hundreds of thousands of dollars for construction, can divert the waters of this stream to advantage. Thus upwards of 350,000
acres of bottom lands have remained unimproved and unoccupied, while enormous quantities of water in the Platte River have gone to waste, which would have made these uninhabited tracts of land bloom with luxuriant vegetation.

Mr. F. H. Harvey, of Douglas, Wyoming, has apparently solved the problem of irrigation for the Platte Valley in Wyoming. His ingenious plan for raising the waters of the river has, so far, proved a success; and it seems that the practical demonstration of his plan, because of its cheapness, simplicity and ability, is going to work a revolution in the methods of taking out water from the Platte River for irrigation, as well as along other streams of like characteristics.

We are indebted to the Irrigation Age for the cuts which we insert, fully illustrating Mr. Harvey's new water motor and its method of raising water for the purposes of irrigation. We quote Mr. J. A. Breckons' description of
this motor and its relation to the Platte River, as given in the *Irrigation Age* of June, 1894. We have personally inspected the wheel, and regard Mr. Breckons’ description as accurate and complete.

"The Platte River, in its course through Wyoming, alternately runs in almost level stretches of several miles and then in rapid falls of from 30 to 60 inches in short riffles. Below the riffles, on either side of the stream, are the bottom lands laying with a gentle slope to the river and admirably adapted to irrigation.

"Mr. Harvey has located his motor on one of these riffles, three miles above the town of Douglas, and is now watering 200 acres with it. The motor has sufficient capacity to water 500 additional acres. The river at this point is about 850 feet wide and makes a sharp curve at the head of the riffle. A low dam of piles and loose stones starting at the head of the riffle was first con-

**VIEW FROM TOP OF PLANT.**

structured diagonally from the right bank of the stream to a point about 150 feet from the left bank. From the end of this dam a strong wing dam 10 feet wide and 12 high,
The Harvey Water Motor.
made of piles, plank and loose stone, was built, extending at an angle of almost 20 degrees towards the shore for 50 feet, and then for 12 feet directly down the stream parallel with the shore. A similar wing dam was constructed from the shore, the two forming a letter Y, with the stem down the stream. The main current of the stream passes over the low dam, but a side current is directed by it into the Y where the water-wheel is placed. The wheel is a combination of an undershot and breast wheel. The 30 inches of fall which the river makes in the riffle is concentrated in the chute carrying the water through the Y. With a 10 foot diameter wheel, 14 feet long, 60 horse power is secured. This in the Harvey plant is used at present time to run a 3½ inch centrifugal pump, which raises 1,000 gallons of water per minute a height of 16 feet. The same power will run a 5 inch pump, raising 7,000 gallons per minute. The wheel is hung on a swinging frame and is balanced by a counter weight. Its gearing is a sprocket wheel so that it can be raised or lowered with the varying rise or fall of the river without any readjustment of gearing. Logs have been run under it and it has ridden over them like a pneumatic-
tired bicycle passing over a rail or stick without injury to the wheel or jar to the pumping machinery.

"The wheel was started on April 17th, a large party of Douglas citizens being present, and has been running continuously day and night since that time at an expenditure of about one cent per day, this expenditure being for oil on the pump connections. No engineer or watchmen is needed and the wheel works on while the owner works in the field or sleeps, every 24 hours pouring 1,440,000 gallons of water on the thirsty land.

"The cost of the wheel, compared with what it accomplishes, is nominal. Labor and material, including the pump on the Harvey plant, amounted to $1,200. As much of the work was experimental it was necessarily slow. A like plant can be put in for $800, and most of the work can be done by the ranchman himself.

"Since the wheel has been running, scores of ranchmen have visited the plant and preparations are already being made to put in four plants at various places along the river, one of them, where the riffle has a fall of 50 inches, to be of 100 horse power.

"Mr. Harvey will not undertake to patent any feature of his motor, and will cheerfully furnish information as to its construction to anyone. The enhancement in value of his own property, and the satisfaction of seeing central
Wyoming develop, is all the reward he wishes for his invention."

We trust this new water motor for the purpose of irrigation, will awaken great interest among the ranchmen of Wyoming who are living along our large streams. We believe it to be a cheap, reliable and effective method of taking water out of our large streams for irrigation, and after personal inspection, can fully endorse this motor, believing that the information herewith given may prove of great value to the agricultural interests of Wyoming.