
UNIVERSITY OF CALIFORNIA.

AGRICULTURAL EXPERIMENT STATION.

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The Work of the College of Agriculture,

AND EXPERIMENT STATIONS.

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THE WORK OF THE COLLEGE OF AGRICULTURE,*

AND EXPERIMENT STATIONS.

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One of the chief difficulties under which the College of Agriculture at Berkeley labors is the lack of acquaintance of the farming population with it. The most unfounded impressions and aspersions upon its work sometimes gain circulation and credence among them; hence, it is thought advisable at this time to go somewhat into detail in presenting to the public the various features of our work, and the methods we pursue in making it available and practicably useful to the farmer.

Our work is of a twofold nature: *instruction* and *experimentation*. A third topic might be added, intimately connected with the others: The ascertainment of the agricultural features of the State, or what, if it were organized independently, would be called an *agricultural survey*.

WORK OF INSTRUCTION.

As to instruction, we are prepared to give it, and do give it, in three different ways:

1. By lectures and practical exercises—"laboratory work"—to students in the University;
2. Lectures to farmers' meetings, or "Institutes," at different points in the State;
3. By an extended correspondence, mostly in reply to questions asked by farmers, for information or advice. This part of our work is intimately connected with that of experimentation; and it may be said right here that it is perhaps the most laborious part, involving the writing, annually, of from five to six thousand letters, many of which require prolonged research. They occupy a large share of the Director's personal time.

UNIVERSITY COURSES.

Now, as to our University courses: We think we offer at Berkeley the kind of instruction most needed by our young men. We do not pretend to teach them the actual operation of plowing and hoeing by making them work; we think they either know how to do that already, or can learn it in a few days when they return to the farm. What we do teach them is, why to plow and hoe at all, and how and when to do it to the best advantage. That is, we teach them the *principles* on which they must base all their farm work, in order to compete successfully in the hot race that is now on in agriculture, as well as in all industries, between

* Revised from lectures delivered at various Farmers' Institutes.

the most remote regions of the globe. The time is past when mere hard work without the use of brains will command success. Hard work is still needed as much as ever, but it needs to be shaped so as to be done to the best possible advantage.

We are well equipped and officered for most of the work of instruction; what we lack is not there because we have not had the demand justifying the expenditure. However, the only important department not provided for at Berkeley is veterinary science, and that will doubtless be filled so soon as any demand arises. A veterinary college affiliated with the University exists at San Francisco.

Student Labor.—Some may differ with us on this point, and think we ought to put the boys into what would be called practical work, as is done in trade schools. The trouble is that the farmer's trade, unlike the carpenter's or blacksmith's, must be varied from place to place, and that sleight-of-hand is the least part of his difficulties. Soils and climates vary infinitely more than do woods or metals; it takes an educated judgment to deal with the former, and that judgment must either be acquired locally by long and costly experience, or it must be imparted by education. In the old countries, until recently, the experience of the forefathers was enough; at present that experience has largely become worthless, on account of the keen competition of all the world, now connected by means of steam and electricity.

Here in California we have not even the forefathers' experience to go upon; it is therefore doubly necessary that we should possess ourselves of the principles upon which we must depend in order to deal with the facts as we find them in a new country.

Some imagine that actual farm work is omitted from our program because of prejudice on the part of students against such work. On the contrary, we continually have more applications for paid work from students of all departments than we can possibly employ; a student who works his way is universally respected and applauded. No such snobbishness exists at the University of California in these days.

But the fact is that the students do not want, if they can help it, to spend on uninstructional labor the time allotted them for their education. *Instructional* labor—such as is needed to give the student a thorough understanding and some practice in actual manipulation, say in grafting, beekeeping, etc.—forms part of our courses. The time given by most of our young men to education is too short to be encroached upon by useless mechanical exercise.

Attendance.—But when the lecture rooms of the Agricultural College are but partially filled, while those of other departments are overcrowded, we can hardly wonder that the Regents hesitate to appropriate more funds toward the instruction of these few. *That*, in fact, is the objection we have to contend with, year after year, even for the maintenance of our existing staff and means of work. We are naturally told that it is the business of the University, first of all, to supply the actual pressing demand for education, and that the farmers evidently do not want special training for their sons.

By an actual record of in-trants giving the occupation of their parents, it appears that out of 481 new students entering in 1896, 85 are the sons and daughters of farmers; and of the total, 3 have entered the full agri-

cultural course, and 2 as special students, not one of whom is a farmer's son.

The allegation, however, that only two or three students are taught by the staff of the Agricultural College, is a gross misrepresentation. The actual attendance at the agricultural courses proper, as shown by our last year's class rolls, was over one hundred. Of course, several times that number might just as well have been instructed, for the labor on the part of the instructor is just the same. The classes under agricultural instruction are largely made up of students whose chief line of study is in other departments, to which they are therefore credited in the annual Register.

On this question of attendance, which is a sore point in all agricultural colleges in the United States when their *bona fide* agricultural graduates are counted,* we can but repeat what has been frequently expressed in word and print heretofore; namely, that so long as our soils continue to produce remunerative crops, or remain productive without imperative need of fertilization, rotation, etc., and new lands remain to be occupied, the attendance, at our colleges, of farmers' sons intending to return to the farm will be comparatively slight; but as soon as the shoe begins to pinch, and intelligent and frugal husbandry becomes a necessity, our agricultural colleges and schools will receive a correspondingly increased attendance. The beginning in such a movement is already seen in the attendance, as *special students*, of those often of mature age, who intend to engage in agricultural branches requiring professional information, training for observation, and educated judgment. It is the absence of demand for agricultural experts in this country that keeps down the number of full-course graduates to a few persons annually. In California, however, the fact that investments in orchards and vineyards are permanent for a number of years and bring about a one-sided wear in the soil, makes it necessary to work on rational lines sooner than is mostly done elsewhere. Horticulture requires in an eminent degree the use of knowledge and brains, and it is from horticulturists that most of our students now come.

Unusual

Besides, the large area of the State and its indefinitely varied climates and soils call for the exercise of an *annual* degree of judgment and brains, the more as in a great number of cases there is no experience and precedent to go upon. It would therefore seem especially needful that our young men intending to be farmers should be trained to use all the resources that agricultural science places at their command, to save themselves from costly mistakes in their practice.

We have been told that farmers do not send their sons because they fear they will be "educated away from the farm." But as a matter of fact a very large proportion of our University students *are* farmers' sons, as already shown; and they *are sent by their parents to other departments*—literary, scientific, and other professional courses—giving their own profession the go-by. It is the old story of the tendency of the rural population toward the cities, where more "fun" and (supposedly) less hard work can be had than on the farm. That is the

*In the last report of one of the oldest agricultural colleges in the United States, established purposely at a distance from all literary institutions, the Professor of Agriculture notes as a marked increase over former years, the fact that *three* freshmen and *three* sophomores have entered and are now in the regular agricultural course.

problem all the world over, in Europe as well as here. It certainly cannot be remedied by holding the boy's "nose to the grindstone," whether at home or in college; the time for such measures has gone by. It is only by elevating the farmers' pursuit to a higher plane, both intellectually and (by the aid of such associations as the Grange and Farmers' Clubs) socially, that the current will ever be reversed.

Conditions of Admission.—Some say that we have made the conditions for admission too high for the preparation that the farmers' sons are usually able to obtain. This may be true as regards what we call our "regular" course which leads to a degree; and this is as it should be, for the agricultural teacher and expert, for whom this course is designed, must of necessity have a good, thorough foundation for his studies and should not otherwise have a University degree. But these requirements do not exclude any students who do *not* work for a degree; these can come in under the head of *Special Students in Agriculture*, and the sole condition of their admission is that they shall have sufficient preparation to profit by our instruction, and that they shall conduct themselves properly and work faithfully. There are courses enough to occupy the full time of such students for two years, and which do not require any very extended preparation, and can be taken by young men who have had a grammar school training and some experience in practical farming. Very young untrained boys we do not like to have attend, because we cannot undertake to take care of them among so many as now attend the University; nor can they usually profit adequately by our courses.

*Agricultural Education in Europe.**—"As an object-lesson in this matter, let us consider briefly the general aspects of agricultural education in Europe. We there find that, in all cases, there is at the head of the system one or more departments or colleges of University grade, which educate both the teachers for the institutions of the lower grades, and the agricultural experts that are to stand at the head of large estates, and thus lead the ~~van of~~ agricultural progress in practice. This appears to be a logically necessary function, the very condition precedent of any rational agricultural education whatever. Yet this has been one of the most bitterly contested points in this country, so that in many States the attempt has been to make all agricultural instruction mainly 'practical,' even when only a single institution could be established on the basis of the available funds. I think experience has shown that this is an error; that *instruction of the highest grade for the education of the leaders of progress is the true function of a State college of agriculture*. For in almost every case the colleges whose curriculum was organized on the proper 'practical' plan have, in the course of time, been compelled to raise the standards to a higher plane, with an obvious tendency to place them on a University grade.

"To discuss the propriety or relative advantage of the organic connection of the agricultural college with the literary and scientific University would carry us beyond the limits of this paper. But we cannot reconcile ourselves to the thought of the official and permanent recognition, as a factor in shaping our educational policy, of the snob-

*Revised abstract from the article under this head in the Report of the College of Agriculture for 1892-93.

business which looks down upon agriculture as a vocation of inferior degree. It is truly remarkable that in republican America prejudices should be allowed a foothold which even in monarchical Germany dare not show their face. The strong and influential representation of the agricultural element in the German Reichstag stands in marked contrast to the manner in which the farmers' interests are made to take a 'back seat' in our legislative assemblies; not so much because farmers are not there, but rather because for lack of training they cannot make themselves felt as against their well-equipped competitors of the politico-legal profession. It is only by correspondingly thorough training, connected with their own pursuit, that this state of things can be remedied.

Lower-Grade Agricultural Schools.—"It is evident that it will be long before the mass of farmers will take such a higher course of education, even if it were possible to accommodate the rank and file in the State Agricultural College. There are substantially two plans upon which such instruction in the principles of agriculture as it is possible to impart within the limited time usually at the disposal of farmers' sons can be imparted. One is the plan adopted by Germany, of separate institutions on a lower plane than the State college, standing substantially in the place of the high school for those who do not desire the latter kind of education. The other is the system adopted by France, of making instruction in agriculture run parallel with the other grades and subjects of education, throughout the public school course, in rural districts, largely by 'circuit-riding' teachers assigned to definite districts.

"Even the latter plan would, in this country, encounter almost insuperable difficulties at the present time, in the lack of qualifications for such instruction on the part of common-school teachers, and the scarcity even of qualified special teachers in this line, which is not likely to be remedied within any short space of time. Moreover, it is apt to load down too much the already crowded curriculum of the schools, curtailing still further the time for needful general culture. In my view, however, the establishment of a sufficient number of schools corresponding to the second grade of the Prussian system and provided with specially qualified teachers, would be the appropriate course to be pursued in giving a proper and sufficient opportunity for professional education in response to the demand of the progressive portion of the farming population who desire to retain their sons within their own immediate sphere of influence in the rural districts, while still enabling them to avail themselves of the advantages of rational agriculture.

"For the mass of farmers' boys, some instruction in agricultural topics should unquestionably be introduced into the public schools. The most inexpensive and feasible way to accomplish this would be by means of periodic visits, by well-qualified agricultural teachers, to schools in the rural districts, within the limits, say, of a county; giving short elementary courses, adapted to the needs of the several districts. That such elementary teaching, putting applied science into popular form, is more difficult and requires a broader grasp on the subject than to teach a specialty to higher classes, is a well-known fact.

"It may be said that this would still further enhance the already heavy burden imposed upon taxpayers for the maintenance of the public schools. To this I reply that it is difficult to imagine a more important duty in the life of parents than the proper education of their

children in their life pursuits; and that their duty to them can hardly be considered as fulfilled by the payment of the traditional \$10 to \$15 per annum 'per census child.' There are a great number of other subjects of expenditure which they can better afford to cut short; and it is certain that without such additional provision for the better education of the farming population in their pursuit, the State colleges are powerless to bring about the desired result.

"The trade schools now being established at many points in the United States, and of which two will belong to San Francisco, while one may be established in close connection with the University, seem to point the way in which the desired solution for the problem of secondary education for the farming population lies. There is, however, one essential difference, inherent in the nature of the case, to wit: that in trade schools the acquisition of manual dexterity or 'handicraft' plays a prominent part, while instruction in principles may be quite simple and rudimentary; whereas in the farmer's pursuit the handicraft is so readily acquired that most boys attain it more or less perfectly on the home farm by daily practice, while the *principles* upon which the operations of the farm must be based to secure the best results are the main thing needful to be acquired in the school—and, unfortunately, these principles are very complex, and farm practice must be materially modified according to local conditions. Hence it is that 'model farms' can rarely represent more than the best local practice, which will mislead the learner when applied elsewhere. This, in a country where the population is so large and varied, and is so continually on the move, renders necessary a higher grade of instruction than that which is given in the second-grade schools of Europe. The growth of such schools must almost necessarily be slow on this account alone; for the teachers qualified for such instruction, embracing both theory and practice in a nutshell, have still to be educated in this country."

Without the agricultural college of University grade, teachers for the lower grades could not be formed. But naturally the agricultural college cannot aim to educate the mass of farmers, any more than the other departments of the University can educate the population of the whole State. That is physically impossible in either case. There must be graded schools in all departments of knowledge; for otherwise it is impracticable to carry instruction near enough to the doors of the population.

But clearly, no practicable organization of an agricultural college, here or elsewhere, can provide for the education of the masses. The masses cannot travel to it, nor can the college be perpetually on wheels; were it to do so it would so scatter its work as to make no permanent impression anywhere.

The agricultural school of the University grade is the first need, especially in a new country where the best resources of science are required to study and conform to new conditions. It must educate the teachers, the leaders of progress, and the experts, and educate these thoroughly. But no single institution can usefully reach the masses and effect in agricultural instruction what cannot be accomplished in other branches of knowledge.

FARMERS' INSTITUTES.

As to the *Farmers' Institutes*, we started out hopefully seven years ago, with an allowance of \$1,000 for the year's expenses, appropriated by the Regents for the purpose. In our rules regarding the holding of these meetings we have adopted precisely the policy maintained by the States in which they have been most successful. Accepting the maxim that what is given as an absolute gratuity is little valued, we have required some previous manifestation of active interest on the part of the community desiring to have an institute meeting held among them; namely, advertising the program and providing for a hall. Failing this, we have not thought ourselves justified in giving our time and expenses of travel to a mere corporal's guard whom we might persuade by letters to attend. We will help those who are willing to help themselves, but cannot afford to waste our efforts on the indifferent. If the State were to employ a suitable person to travel around and push the matter, as has been done in some of the older States, more might be accomplished; but this is more than the University can do without direct assistance from the State, given expressly for the purpose.

The first year we spent about \$400 out of the \$1,000 allowed; but hoping that a wider interest would be manifested the next year, the same appropriation was continued. Again only a fraction of the amount was actually expended, notwithstanding many appeals made by us to prominent persons in different parts of the State. Then the Regents, as was natural, reduced the allowance to \$500 per annum, since that seemed to be the maximum likely to be required; and even that was not fully expended that year. Since then we find that in consequence of a revival of interest and the organization of "Farmers' Clubs" in Southern California, we need more in that section alone; outside of any meetings that may be called for north of the Tehachapi. Unfortunately, the financial stress now resting on the University has rendered any supplementary appropriations difficult; but this year (1896) an extra effort has been made by cutting down other needed work.

We cannot persuade ourselves that an expense of from \$10 to \$20 would prevent a community desiring, and likely to be benefited by such meetings, from preparing for them according to our requirements. Two representatives of the University have, as a rule, attended them, omitting their class exercises for the time. We have also employed outside help by paying well-qualified persons, when only one member of our staff could attend. We believe these meetings have excited considerable interest and have been profitable to those attending; but much larger audiences might have derived the same benefits. The subjects that have been brought before them have certainly been of considerable practical interest, and the discussions and questions asked have brought out many additional points of value, not only to the audience, but also to ourselves, in giving us an insight into the needs of the several communities in the way of information, and a knowledge of many facts that, in so large a State as California, could only be otherwise ascertained by a systematic agricultural survey.

CORRESPONDENCE.

As for the third line of our instructional work—the *correspondence* in answer to questions asked—it shows strikingly the need for just the kind of instruction given to all who care to ask for it. It is often a most laborious task to unravel the unknown and, in most cases, poorly described facts of each case, upon which the answer must be based; and it is curious to note, in the correspondence addressed to the College, the native good sense mostly shown in the questions asked, marred only by the questioner's unacquaintance with the first principles of scientific agriculture, which even a short course of school or college instruction would have remedied. Very often, former students and graduates of the University, who have at last brought up on a ranch, end their letters with regrets that when studying they did not take the agricultural instead of some other course preferred by them at the time. Learning by dribblets, as they now do by our letters, is as laborious for them as it is to us, who could as easily teach a score as the one correspondent to whom we write. Yet we deem the time so spent profitably employed, since it is our business to teach and give advice, whether to the few or to the many. Moreover, this correspondence puts the instructors in possession of a vast number of facts that, in their proper place, fill some gap existing in their knowledge of the agricultural features of the State. For it is quite obvious that, so far as possible, they should teach, not only what should be done in certain supposititious cases, but what, in fact and in practice, are the problems students will have to deal with in their own State.

Need of an Agricultural Survey.—But in order to do this we must be in possession of these facts, and unfortunately this is the case as yet but to a limited extent, since we have not, and never have had, the means for carrying out a systematic agricultural survey of the State. The miners have the Mining Bureau for that purpose in connection with their industry; but the farmer is left to his own devices, to find his way as best he may; and we grope along gathering dribblets of information here and there, and gradually, tentatively putting them together into a more or less connected whole.

All the facts that bear upon soil quality are entered on a map as they come in, and out of this mosaic we gradually obtain something like a connected picture, which serves us to make shrewd conjectures as regards points not directly covered by our information. It is a slow and unsatisfactory mode of work, but it is all we can do at present.

Examinations of Soils and Waters.—It is one of the superstitions of many of those who ask for information, that they imagine us to be able to determine what they want to know from, say, a thimbleful of soil, a gill of water, or two or three fruits sent for analysis. It is hardly necessary to insist that we work by common sense and thorough observation, and not by guesswork and jumping at conclusions; and that we cannot deduce correct conclusions from samples incorrectly or carelessly taken, and sent to us without an intelligible account of their mode of occurrence and natural conditions.

The frequent requests for the examination of soils with a view to determining their permanent value for various cultures adapted to local

climates, prove the great need of such investigations, and involve a great deal of very difficult work, which embraces not only the chemical and physical properties of the soil, but also a full consideration of the conditions of the subsoil, drainage, "lay," and local climatic factors. Yet there is hardly another question so vitally important to the settlement of the State and the prosperity of the farmer, since in thousands of cases his substance is wasted upon lands intrinsically unsuited to his purposes, not to mention some colonization schemes that have resulted in the utter bankruptcy of the colonists; partly from their ignorance, partly from intentional fraud on the part of the originators of the enterprise. It is in this connection particularly that the lack of an agricultural survey of the State becomes painfully felt; the reports and samples sent us are frequently, and sometimes unavoidably, very imperfect, and leave a great deal of room for conjecture and therefore for error. For this reason a special chapter in the Report for 1893-94 has been given to directions for land examination, with the hope that many farmers might thus be enabled to determine for themselves at least the chief faults that may render certain lands undesirable for their purposes. Printed directions for taking samples properly representing lands under consideration, are mailed to applicants for such information. These samples are then subjected to such examination, including physical and chemical analysis when necessary, as may be required to determine their value, faults, or virtues.

But as a matter of fact the staff of the Station is quite unequal to the demands made upon it for work of this character, which should be made the subject of a special survey, on behalf of the State. At this time our collection of California soils embraces about 1,900 samples, representing most of the more important agricultural sections.

Irrigation waters also form a considerable item in the examinations asked for; and being usually of wide public importance, the Station has thus far complied unhesitatingly with such requests, as is shown in our reports. The demand for the examination of waters for domestic use, though of wide importance in this State where saline waters are so common and their use so frequently injurious to the health of man and beast, has become so great that it has become necessary to restrict the work to the most needful points, and to exclude many cases apparently of purely private interest, such as mineral waters. Still it is clear that good water for domestic and irrigation use is scarcely second in importance to the soil itself, and should receive its share of attention.

Insect Pests and Plant Diseases.—One of the prominent subjects of inquiry, and often accompanied by samples, is the determination of insect pests and plant diseases of all kinds, with request for prescription of remedies. As a general answer to many such requests, a short "special bulletin" has been issued; and our reports give general advice about discovering insect depredators and how to treat them. But a large number of cases require special correspondence and investigation, and not infrequently, visits to the spot. In this connection the examination of insecticides commercially sold has involved a great deal of labor, and has, in many cases, led to the discovery of extensive adulterations (as in the case of Paris green, "concentrated lye," and others); the publications of the facts being followed by peremptory demand for pure articles on the part of the buyers.

Fertilizer-Examination.—It has been found impracticable to extend such examinations to the commercial fertilizers sold in our markets, because the reports given in the case of samples found in accordance with guarantee were often used to cover the entire "brand," for the purity of which, in the absence of State inspection, the Station had no guarantee whatever. Until a fertilizer-control law is enacted, the Station cannot undertake to intervene, save in cases of gross adulteration brought to our notice by consumers.

CENTRAL STATION WORK.

Distribution of Seeds, Plants, and Scions.—The branch of the work of our Station which relates to the introduction and trial of economic plants from all parts of the world is steadily advancing, and commanding wider public interest. Our plan of distributing to volunteer experimenters, plants or seeds of those growths which seem most promising after trial upon the grounds of our own stations, seems to commend itself more and more each year to the people of the State. The increasing popular interest in the distribution is also seen in the fact that 1,487 applicants were supplied with seeds and plants in 1896, as compared with 925 in 1895. Material was sent to applicants at 382 post offices in 53 counties of California. We desire extension of this interest, and of the territory (mainly within the State of California) served by the distribution, because the data thus secured by wider local trials enable us to more accurately determine the adaptations and values of the plants which we introduce. We desire, however, to emphasize the fact that we do not maintain a free distribution, nor do we conduct a seed business, nor can we undertake to supply any miscellaneous seeds or plants which the applicant may desire. This is a function of the seed trade which we have no desire to assume. We always welcome suggestions of growths from those who have observed them locally or abroad, and such suggestions we are often able to turn to practical account through systematic trial, and subsequent distribution, if our results warrant it. We require the applicant to pay a small amount for each thing received, partly to bear the cost of distribution, but chiefly as a guaranty that he has not merely an idle desire for what can be had for nothing, but intends to make trials for a definite end, and will report results to us.

It is impossible to give in a brief paragraph even an outline of this important work, which has proceeded with increasing popularity for the last eighteen years. It may be said, however, that the distribution has included forest and ornamental trees in great variety, cereals from all parts of the world, dry-land grasses and forage plants from other arid regions everywhere, grapevines from Europe and Asia, olive varieties from the most famous districts of South European countries, garden plants in large variety, etc. In this large list, of which our reports give full details of trial in all parts of the State, perhaps the most striking success is the Australian saltbush for alkali soils; first demonstrated at the Tulare culture sub-station. This plant has peerless adaptation for growing on soils too alkaline to support any other useful growth. So strongly are owners of alkaline lands impressed with this fact that thousands of acres were sown last winter. Enthusiastic correspondents

write us that the trial and announcement of the suitability of this plant are worth more to California than all the money the University Experiment Stations have cost from their beginning. The introduction of this plant to owners of waste alkali lands is certainly one of the most striking achievements in our long continued policy of trial and distribution of economic plants.

Analyses of Agricultural Products.—As a guide to intelligent fertilization for the maintenance of production, and also for the determination of the food values of the several fruits and field crops, extensive series of analyses of these materials have been carried out by the Station. Contrary to the general impression, such investigations have thus far been made only to a very limited extent so far as our chief fruits are concerned; so that reliable averages could not be deduced from the data on record. This was found to be eminently true as regards, especially, citrus fruits, olives, and nuts, the products of southern climates; and even the apricot and prune could not be said to be fairly represented as yet. Our very first results in this line showed serious differences between the composition of most of our fruits and those analyzed elsewhere; in respect to the oil-contents of various kinds of olives, the record was almost a blank; the nutritive value of California prunes and apricots was found to exceed materially that recorded elsewhere. We have thus filled numerous serious gaps in the knowledge of many of our products, but a great deal yet remains to be done.

Besides the fruits, many analyses of cattle feeds, sugar beets, etc., are constantly being made, in many cases showing unexpected results important for practical use.

Viticultural Work.—Last, but not least, the viticultural work of the Station requires notice. It was established as a special feature of our work in 1880, by the same Act that created the State Viticultural Commission. It provided only for laboratory work, but authorized the Regents to accept donations of land for experimental vineyards. In pursuance of the latter provision, a number of experimental plots were established under private auspices; and from these a large amount of important material and data was derived, as is shown by our reports. But the difficulties of carrying on exact work under the simultaneous pressure of the private work and interests of a vineyard and winery, were found to interpose serious obstacles; so that when it became possible to establish culture stations under our direct and exclusive control, all but one of the stations under private auspices were abandoned. The object of this work was, of course, to determine the varieties of grapes best adapted to various purposes, in the various climatic and soil regions of the State, both in the vineyard and (as to their wine-making qualities) in vinification, on a (necessarily) small scale, in the viticultural laboratory at the University. These were among the most essential questions to be settled, since grapes from all grape-growing countries in the world had been almost indiscriminately planted anywhere in the State, producing nondescript wines, unacceptable in commerce, and too frequently poorly made, seriously damaging the reputation of California wines in the world's markets. Other outside and especially winery work, having been put in charge of the Viticultural Commission, was not attempted by us until, the Commission having been abolished by legislative Act

in 1894, its technical work was turned over to the University, with a very limited appropriation (about one fifth of that granted to the Viticultural Commission). That portion of the work has but just begun in our hands.

The result of the laboratory work has been to establish a definite basis for rational wine-production in this State, by determining both the cultural and wine-making qualities of all the more important grape-varieties in the several regions where our stations were, or are now located. It is true that the depression under which the wine interest has labored for a number of years past, has prevented viticulturists from availing themselves, to any great extent, of the guiding facts established by us; but it is quite certain that in future undertakings of this kind, as well as in any rational winery practice in the immediate future, these facts will have to be taken into definite consideration if the product is to be as good as it can be made under local conditions; and as competition as well as the critical judging of wines make themselves more plainly felt, such practice must inevitably take precedence of the haphazard, irrational modes of procedure that have so largely prevailed heretofore. Our work in this line represents the largest and most complete systematic investigation of the kind on record thus far in any country.

THE CULTURE WORK OF THE EXPERIMENT STATIONS.

The portion of this work connected with our extended correspondence has already been referred to; it combines instruction and experimental work, whether on samples sent, or on conditions described by the writers, sometimes well, sometimes poorly; sometimes with the purpose of having fault to find with us for not knowing, or being able to divine, by official afflatus, what they have failed to tell us about their conditions, in a State 750 miles long by 200 miles wide, embracing within its limits about a score of climates. This, of course, is a cheap method of fault-finding. But it is an inevitable incident to what I consider the primary duty of experiment stations in the newer States; namely, to direct their work, not so much toward the further study of the questions that occupy the stations in the East and in Europe, but more particularly toward the solution of problems encountered by the settler in a new country, whose very seasons are unfamiliar to the Eastern immigrant, and where agricultural practice must be shaped on wholly different lines, and very many of the old landmarks fail. Thus, in the East, "poor sandy soil" has passed into an axiom; in California, many of the richest and most durable lands are of this very character, only the sand is of a very different nature. "Subsoil" is here, in very many cases, non-existent in the Eastern sense, which deprecates the turning up of that layer as damaging to the crop prospects for the season. The natural faults of lands here are as different as their virtues, in many ways. All these are matters of first importance where new lands are constantly being occupied, where the agricultural possibilities of millions of acres are still in question, and therefore new problems are constantly encountered. It requires time to study these things, and we cannot carry on this work, and such as is done in the Old World stations, at one and the same time, with the limited means at our command. We cannot, for instance,

prosecute a series of fertilizer experiments, which are mainly of local interest, while leaving aside the larger problems upon which the settlement and progress of the State primarily depend.

Our outlying sub-stations were established with the primary object of studying the success of various promising culture plants under the climatic and soil conditions of the respective sections; the location being selected with care so as to be, as nearly as possible, representative of the predominant conditions of an important region. As it is rarely possible to get more than two or three out of the numerous soils of one region within the limits of the station grounds, and as these are especially selected as *virgin* ground, it is of necessity the chief object to determine their behavior under culture with the various crops, in their *natural* condition. And as few fresh soils, at least in California, can be expected to respond remuneratively to fertilization, it is useless to attempt such tests there. *Fertilization tests must be made where the land has become at least partially depleted*; and, taking the State as a whole, this as yet happens only in exceptional cases. Of course, we give our assistance in these lines as far as can be done without actual possession of the land, and personal supervision; but we cannot hold ourselves responsible for all the mistakes made in the statements of cases in the application of fertilizers, and in the observation of the results. Such experiments being, moreover, mainly of local interest, in their application to a particular soil from which that even of the next field may differ very materially, cannot claim precedence over questions of general interest.

The *Central Station* at Berkeley was the first established, and is the oldest in the United States. As the land there had been cultivated to grain for thirty years before, we at once set about making fertilizer tests, which were continued for four or five years. We soon determined what would and would not pay on those soils; but it gave us not the slightest clew to what would be needed elsewhere. We tried to get Granges and local clubs to make trials on "tired lands" elsewhere, but found this a very difficult and unsatisfactory matter. From the first it was insisted in our reports to the Regents that culture stations must be established in other parts of the State, in order to observe the behavior of culture plants in the several climatic regions; but no funds were available for the purpose until the "Hatch Experiment Station Bill" supplied the sum of \$15,000 per annum for experimental purposes. From this fund have been established and carried to their present development the four culture sub-stations located, respectively, in the Chino Valley, near Paso Robles, near Tulare, and in the Sierra foothills in Amador County. We found that after these had been equipped, it was not practicable to establish additional stations in the regions still unrepresented, as the running expenses and the elaboration and discussion of their results at the Central Station (which itself is, however, carried on at the expense of the University) would not permit of the maintenance of more stations. Aside from these four stations, the two forestry stations lately turned over to us by the abolition of the Forestry Commission, are maintained out of the very inadequate appropriation of \$2,500 per annum for both made therefor by the State. A similar sum is appropriated by the State for work in viticulture since the abolition of the Viticultural Commission; and this, with the vineyards already in bearing at the several stations, and the opportunity we now for the first time

have of traveling in the grape-growing regions, and making winery experiments, will enable us to do a good deal of work in that line hereafter.

Five culture stations to represent this State is, of course, quite inadequate to do justice to all sections, but it is all we can do with the funds at our disposal.

Results Obtained in Culture Station Work.—It has, of course, taken time to bring these culture stations into bearing, as it would on any farm. They are just now arriving at their full stage of usefulness, and will be heard from much more frequently hereafter than has been the case heretofore. Yet we have already achieved some valuable results; the Tulare station, in particular, has yielded us facts in regard to the possibility and methods of reclaiming our alkali lands, that were hardly foreseen when it was established, and active work in that line is being done both there and at the Chino tract, that will be of great importance in the future. Contrary to the opinions held all over the world, and originally by myself on that point, experiments at the Chino tract, following the experiences of the beet-growers, have shown that high-grade sugar beets can be grown on land containing a considerable amount of a certain kind of alkali; which logically determines the adaptability to that culture of tens of thousands of acres elsewhere heretofore supposed to be of little use and value. A detailed account of these investigations is given in our last report.

We have also proved the perfect adaptability of at least one of the Australian saltbushes to all but the strongest of our alkali lands, and the fact that all kinds of stock will eat this herbage with relish and profit. Few persons who have not paid special attention to the enormous extent to which alkali prevails in some sections of the State, have any idea how much these investigations mean for the settlement of some of its most attractive farming lands.

At the stations near Paso Robles and in the Foothills, as well as especially at Tulare, we have shown the special adaptation and non-adaptation of a multitude of fruit varieties, regarding which the farmers were completely at sea. The studies made of olives grown at these several stations have shown most important facts regarding the oil-contents of the same variety at different points, and of the different varieties at the same point; showing differences great enough to throw the balance of profit or loss to the grower far to one or the other side, and thus saving the cost of the grafting-over of whole orchards.

The extensive orchards and vineyards established at the culture stations, and every year enlarged from the most authoritative sources, deserve especial comment. Horticulture in California has greatly needed such collections, correct in nomenclature, pedigreed and registered so as to form the standard in cases of dispute. The extreme difficulty of creating reliable collections is understood by few persons; it is not enough to obtain an apple scion from the orchards even of the Royal Horticultural Society, but every step of its progress must be watched by intelligent skill, and when it fruits a competent pomologist must determine its correctness. Our collections, already unique on the Pacific Coast, are certainly larger than any others in America in such departments as olives, walnuts, prunes, European grapes, apricots, almonds, and many other important classes. The climatic problems presented in many parts

of California—problems unsuspected by early orchardists—require the culture stations to search diligently for the very hardiest as well as for the more tender fruits. In no other American State, or hardly in any ten others, are the requirements in this respect so exacting. The value of these trial orchards and vineyards will steadily increase for years to come, creating centers of distribution, correcting faulty nomenclature, and offering abundant materials for the creation of new varieties.

Painstaking experiments with the cereals, with forage plants, with cotton and other textiles, with root crops, and with hundreds of small but useful cultures, are reported in the various bulletins and annual volumes issued by this department. We have every evidence that the value of this work is appreciated by the classes most concerned. The increasing number of visitors, the enlarged local correspondence with our foremen, the great and growing local demand for seeds, scions, roots, publications, etc., all illustrate the hold which the culture stations have upon the public. Devoted as they are to good practice as well as to sound theory, it is gratifying to find in many instances that the everyday practice of the sub-stations in preparing the soil for a hay crop, or in cultivating the orchard in times of drought, has excited general interest, and won the strongest local approbation. We are often told "You farm better than any one else in the district." Our best foremen are justly becoming men of mark among the tillers of the soil, and if any fall below the high standard required—the happy combination of theory and practice—their places are filled by others more competent and more progressive.

The American public is the most impatient in the world for results in every enterprise. They are unwilling to wait for a timber tree to mature unless it can be accomplished within their own lifetime, be the certainty of the ultimate profit ever so great. Yet, agricultural experiments of short duration are simply worthless as proving either positives or negatives. Seasonal variations are so incisive and so potent that the utmost caution is necessary in coming to sweeping conclusions. Any one can for a time make a showing of success by jumping to conclusions; but the test of time alone can decide whether or not he is dealing with delusions. In no other line of experimentation are the conditions of an experiment so complex and so difficult to control; in no other are the results so frequently the outcome of a totally different cause from the one purposely introduced into the experiment, and therefore wholly inapplicable to any but the particular case in hand.

What we need in our work is more of cordial and intelligent coöperation and less of cheap, captious criticism. The field we are expected to cover is so vast that our means of covering it in all its details are wholly inadequate. We do not pretend to know, from official inspiration, all the complex conditions that may surround some apparently very simple problem somewhere in the great State of California. Neither, probably, does any one else; least of all those who come to a conclusion as quick as they put their eyes upon it. The farmers must help us to ferret out all the facts bearing upon such questions, and with correct information we will do the best that can be done in our present state of knowledge. But it is an old story that it is easy to ask more questions than seven or any other number of wise men can answer; and a great many such questions come to us.

