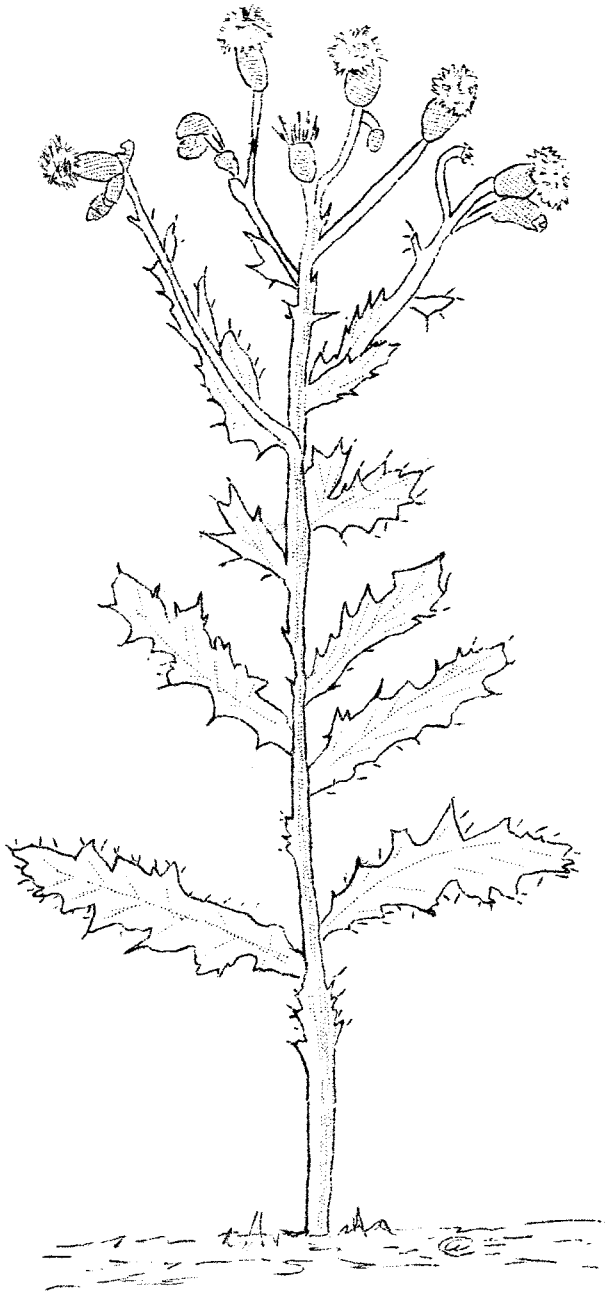
MINUTES

SEVENTH ANNUAL WESTERN WEED CONTROL CONFERENCE



BOISE, IDAHO

JUNE 6-7, 1945

SEVENTH ANNUAL WESTERN WEED CONTROL CONFERENCE

Boise, Idaho

June 6-7, 1945

Wednesday, June 6th
Morning Session

Meeting was called to order at 9:45 A.M. by Chairman Burge, who called on Mr. Henderson to introduce the first speaker.

MR. HENDERSON: It gives me a great deal of pleasure to introduce a man who is qualified to discuss noxious weeds. He is a man who knows something about the noxious weed program here in the State. Most politicians, you know, say they are an honest farmer or have been a farmer, when they run for some kind of a political job. I have had the privilege of knowing the Governor for 25 years. During that time he has lived on a farm in Canyon County and has made his living there as a farmer and livestock breeder, and so it is a privilege to present our own Governor Charles C. Gossett.

GOV. GOSSETT: Mr. Chairman and gentlemen: After that build-up of Bill's here, I don't know if I can qualify or not. I am a farmer -- have been all my life. I know of the many trials and tribulations to be had by a person making his living on the farm. I am glad to see so many of you people here this morning. I want to welcome you to our State. We are glad you have chosen our State for the meeting place of your Seventh Annual Conference, not because I think we have any more weeds than you may have, but because I don't think you are any more interested in the eradication of these weeds than we are. We are really interested, and we are going to devote a lot of effort to this program. We are not doing as much as we should because of the manpower situation, lack of manpower to carry out weed eradication and chemicals and other things that go into a program to make it really successful. I have been a resident of the State for a great many years, and even before I became a resident, I lived in our neighboring state, Oregon, down here, and I have watched these weeds develop, and I have watched the seed industry develop. If you are going to develop good seeds, you are going to have to work at eradicating noxious weeds. I have seen the seed industry develop from nothing to what it is today -- one of the outstanding seed-production areas in the United States. We have seed representatives and seed houses in nearly every town in Southern Idaho. I am fully aware that you can't grow good seeds unless you eradicate the noxious weeds. I am glad you are here. I hope that you men here from the different States will agree and try to interest the Federal government, not only in support of an eradication program, but in a financial support. This weed thing to me is one thing for which we can consistently and conscientiously ask finances. The Federal government owns much of this land. I think the Federal government should be solicited to support this program. Out of this War will undoubtedly come some materials that will be more effective than any we have had up to date. It may be just a hope, but I think we will see that. Now I want to say again that I am glad to be here, and I want to thank you for this opportunity of appearing before you. If you want to come back next year, I hope that you will.

The official Roll Call by States follows:

States Represented	Official Representative
California	Walter S. Ball, State Department of Agriculture
Colorado	Bruce J. Thornton, Experiment Station, Colorado A & M
Idaho	Buford E. Kuhns, Extension Service, Idaho State College
Montana	H. E. Morris, Botany Department, State College
Nevada	Lee Burge, State Department of Agriculture
Oregon	V. H. Freed, Experiment Station, State College
Utah	Geo. L. Hobson, State Department of Agriculture
Washington	Chas. D. Gaines, State Department of Agriculture
Wyoming	Geo. B. Harston, State Department of Agriculture

A motion was made to dispense with the reading of the minutes of the Sixth Annual Conference. Carried.

REPORT OF THE TREASURER:

1943 Balance forwarded		$377.10
1944 Collections		90.00
Expended for stamps, supplies, etc. . . .	$104.90	
Bank service charge	.50	
Balance on hand	361.70	
	$467.10	$467.10

INTRODUCTION OF GUESTS:

CALIFORNIA

W. D. Hay, Federal-State Seed Laboratory, Sacramento
R. W. Underhill, P. O. Box 224, Lafayette
A. S. Crafts, University of California, Davis
W. W. Robbins, University of California, Davis
W. A. Harvey, University of California, Davis
C. A. Ferris, Standard Agricultural Chemicals, P. O. Box 425, San Jose
Harry H. Jucksch, 636 California Street, San Francisco 8
R. S. Broucher, The Dow Chemical Company, Seal Beach
R. N. Raynor, 627 G Street, Davis
C. A. Conant, Veith Chemical Company, Fresno
Walter S. Ball, State Department of Agriculture, Sacramento
M. M. Harris, Sales Manager, Braun-Knecht-Heiman Company, San Francisco

IDAHO

Wilford L. Jensen, County Superintendent, Rexburg
J. W. Kintner, County Weed Supervisor, Idaho Falls
Andrew C. Hansen, County Weed Supervisor, Teton City
Vernon C. Mortensen, State District Director, Route 2, Rexburg
Roy Livermore, County Supervisor, Rigby
Luke Williams, 404 North 21st Street, Boise
J. R. Douglass, Entomologist, P. O. Box 1100, Twin Falls
C. O. McDannel, Caldwell
J. N. Grimes, Weed Supervisor, Twin Falls
H. B. Reynolds, Weed Supervisor, Rupert

IDAHO (Continued)

D. L. Huey, Weed Supervisor, Gooding
W. Lloyd Campbell, Agricultural Adjustment Agency, Boise
B. E. Kuhns, State House, Boise
H. G. Hilfiker, County Agent, Boise
George D. VanDerhoff, Supervisor, Owyhee County, Homedale
Ted Blackstock, Commissioner, Owyhee County, Murphy
George E. Bradley, Agricultural Adjustment Agency, Box 1539, Boise
Jerome Evans, Agricultural Adjustment Agency, Box 1539, Boise
George Hersley, State Department of Agriculture, Boise
D. K. Hendry, Weed Supervisor, Jerome
Charles H. Andrus, County Commissioner, Jerome
Ben E. Potter, County Commissioner, Kimberly
James F. McDevitt, Reilly Atkinson Company, Inc., Boise
C. O. Meacham, Weed Supervisor, Washington County, Weiser
T. H. Van Meter, Box 1839, Boise
V. A. Cox, Superintendent Ada County Weed Control, Box 576, Meridian
D. A. Stubblefield, Superintendent Cougar County Weed Control, 1811 Cleveland Boulevard, Caldwell
Ed Mess, Payette
Jno. R. McKinney, Payette
K. H. Keagas, Agronomy Department, University of Idaho, Moscow
C. T. Seely, Agronomy Division, University of Idaho, Moscow
C. H. McDannel, Caldwell
Ray O. Peterson, County Agent, Caldwell
Culbert Matsen, County Agent, Payette
George L. Yost, Gem Fruit Union, Emmett
T. M. De Coursey, County Commissioner, Route 3, Caldwell
S. L. Pomeroy, County Commissioner, New Plymouth
W. L. Hendrix, President, Idaho Noxious Weed Assn., Courthouse, Boise
M. A. Lyman, State Noxious Weed Inspector, 108 State House, Boise
M. B. Smith, Weed Supervisor, Banner County, Route 2, Pocatello
Clegg Raymond, County Commissioner, McCammon
W. Dean Boyle, Bureau of Reclamation, Region I, Box 937, Boise
Streeter C. Stroup, Weed Supervisor, Payette County, Payette

MONTANA

H. E. Morris, Montana State College, Bozeman

NEVADA

Lee Burge, State Department of Agriculture, Reno

NEW YORK

Fred Berggren, Oldbury Electro-Chemical Co., 22 East 40th Street, New York

OREGON

V. H. Freed, Oregon State College Experiment Station, Corvallis
J. B. Holladay, Assistant County Agent, Ontario
Frank McKennon, Department of Agriculture, Salem
Chester E. Otis, Assistant Extension Specialist in Farm Crops, Oregon State College, Corvallis
Gene Bates, Van Waters & Rogers, Inc., 2133 York Street, Portland 10
Lin E. Harris, Agronomist, Chipman Chemical Company, Portland
Keith Sime, District Manager, Chipman Chemical Company, 6200 Northwest St. Helens Road, Portland
G. M. Whitney, Athena

UTAH

A. F. Bracken, Extension Agronomist, Logan
A. Stark, Wasatch Chemical Company, Salt Lake City
Ray Whiting, District Agricultural Inspector, Ogden
Wynn L. Davis, District Agricultural Inspector, Brigham
Charles De Moisy, U. S. Forest Service, Ogden
George L. Hobson, State Department of Agriculture, Salt Lake City
J. E. White, U. S. Indian Service, Extension Supervisor, Salt Lake City
R. J. Evans, Utah State Agricultural College, Logan
Victor P. Rasmussen, State Department of Agriculture, Salt Lake City

WASHINGTON

W. T. Carmichael, Pacific Coast Borax Company, 1203 Western Avenue, Seattle
Charles D. Gaines, Supervisor Seed Division, State Department of Agriculture, Olympia

WYOMING

E. J. Ward, Commissioner of Agriculture, 310 Capitol Bldg., Cheyenne
George B. Harston, State Entomologist, P. O. Box 785, Powell
Lambert C. Erickson, State Seed Laboratory, Laramie
George W. Boyd, Extension Service, Laramie

WASHINGTON, D. C.

R. B. Balcom, Agronomist, Bureau of Reclamation

PERU

Enrique Summers, Lima

MR. WALTER S. BALL, Chief of the Bureau of Rodent and Weed Control and Seed Inspection, gave the following report:

REPORT OF THE NORTH CENTRAL STATES WEED CONTROL CONFERENCE

In submitting a report of the meeting of the North Central States Weed Control Conference, I wish to state that, following correspondence with your Chairman Mr. Burge and through conference with our own Department, it was decided that the State Department of Agriculture and the Western Weed Control Conference share the expenses of this trip. Therefore, this organization paid for one-half of the total expenses. The North Central Weed Control Conference was called for the purpose of organizing 13 of the North Central States for the purpose of closer coordination and cooperation, very similar to our organization. I was asked to meet with the group to assist them in organizing, and I am happy to report that their organization is set up very similar to that of our Western Weed Control Conference, and for the same purposes.

They had a very good turn-out, some 90 to 100 representatives were in attendance; these were comprised primarily of research, experiment station, and regulatory officials. The program, which lasted two days, was a very full one, starting with breakfast committee meetings and running through the banquet and night addresses. There was a great deal of information presented. I do feel, however - and this is a personal reaction - that more time could have been given to general discussion. I feel free to make this comment inasmuch as I discussed this with several of the men who were responsible for the organization and programming of this meeting. The results of the meeting, as far as organization is concerned, were very successful, inasmuch as it was agreed to form an organization to be known as the North Central States Weed Control Conference. Mr. T. F. Yost of Kansas was elected President; Dr. F. B. Keim, University of Nebraska, Vice-President; and Mr. A. H. Larson of the University of Minnesota, Secretary-Treasurer.

To me, one of the most interesting features of this program was that it was represented by many of our outstanding research and extension workers in the field of weed control, such as, Dr. A. L. Bakke, Professor of Botany of Iowa State College; J. W. Zahnley, Associate Professor of Agronomy, Kansas State College; C. H. Shrader, Director of the Weed and Seed Division, Minnesota Department of Agriculture; and, of course, many others, including some of the younger men in research and extension work, some of whom are devoting full time to weed control problems. The Federal Department was represented by Dr. McCall, Mr. Kephart of Washington, D. C.; Mr. Stahler of Minnesota, and Mr. F. L. Timmons of Kansas.

The meeting started out with a paper given by Mr. C. H. Schrader, Department of Agriculture, Minnesota, with what I thought a very good introduction to such a meeting by stating that, "If the weed losses in the United States estimated by the U. S. Chamber of Commerce were three billions of dollars in 1930, we can easily suspect that they are now nearer five billions of dollars, or an average of more than one hundred million dollars per state, because it is very doubtful if weed control throughout the United States is keeping pace with the increase of weeds and the losses they cause." He further stated that, "Too long have too many of the leaders in agricultural education and research drifted along under the impression that our so-called good, ordinary, farming practices were controlling weeds. We know that this is not generally true. As a result, special weed regulatory and control agencies have been created in many states."

While mentioning the losses and the importance of the weed problem, I should like to mention some of the points which Dr. M. A. McCall, U. S. Department of Agriculture, pointed out in his talk at the banquet the first evening. Dr. McCall summarized the weed situation of the United States, I thought, very well, pointing out many of the facts which most of us are familiar with, but organizing them in such a way that the importance was readily clarified. Inasmuch as Bindweed seemed to be the main theme of this North Central States Meeting, I was much interested in the statement Dr. McCall made in that Bindweed is only one of at least 30 weeds which are truly noxious. Not all of these weeds occupy as much land as Bindweed has invaded, though at least one of them, Johnson Grass, probably occupies an even larger area; and that some of these other weeds, for instance, Russian Knapweed, Whitetop and Poverty Weed, seem to be even more difficult to kill than Bindweed. Altogether there remains, as nearly as we can estimate, more than 2,000,000 acres of good agricultural land virtually out of production because of noxious weeds. He stated further that the Bureau of Reclamation spends more than $100,000 a year dragging weeds out of irrigation canals and drainage ditches under its jurisdiction and even with this expenditure considers the job poorly done. He pointed out further that, "Another most serious weed problem is that of brushy shrub-like weeds, infesting range and pasture lands throughout the United States. According to our by no means complete records, there are 39 kinds or species of shrubs or small trees, each of which infests some 10,000 acres or more of otherwise good pasture or rangeland. Some of these infestations run into millions of acres . . . .

"Altogether some 5,000,000 acres of land that should be in grass are estimated to be occupied by these worthless shrubs."

In speaking of pasture lands, he continued with the following comments relative to permanent or tame pasture lands: "Pastures have always been a major breeding ground for farm weeds. We are now coming to realize, however, that pastures are an important part of good farm plans and operation, and that to return the profits they are capable of yielding, weeds must be controlled. How to control

and eliminate the wastes and losses from weed infestations on the some 300,000,000 acres of farm rotation and permanent pastures, let alone the even larger areas of rangelands, is a challenge to all of us."

Research was given a great deal of consideration, and justly so. I think that this was well brought out by Mr. Swenson from Minnesota who stated that the weed control problem divides itself into three general phases, namely, education, control and research, and that of the three phases mentioned, in his opinion, research was the most important. It was at this point that Mr. Swenson explained that Bindweed in his state was known as "Creeping Jenny", and that there was one incident where a farmer's wife would not let her husband attend a local weed meeting because she did not know who this lady "Creeping Jenny" was; and, so far as she was concerned, he was going to stay at home.

Mr. F. L. Timmons, who was Chairman of the Research Committee, gave a very comprehensive and complete report, much of which I should like to give you, but time will not permit. However, I do want to mention his comments relative to the value of this conference and of similar meetings of workers engaged in the various phases of weed control for the advancement of weed research programs:

"1. The presentation of research papers brings together up-to-date information developed from weed research recently completed or now in progress. The latest experimental results are thus made available to all workers, in most cases in advance of publication.

2. An opportunity is provided for research workers to become acquainted with other workers in the region and to compare their results, methods, and problems to the end that each may develop a clearer understanding of the weed research problems of the region and receive new leads for the solution of the problems in his own state or section.

3. Research workers have an opportunity to meet the workers engaged in the educational and regulatory problems and to study the problems and needs of these programs which research can help to meet.

4. Regular or periodic conferences of weed workers similar to this conference will create increasing and cumulative benefits to both the action and research programs through developing continuity in the exchange of ideas, plans, and information and the consequent better understanding and closer cooperation among the men working in the two closely related fields."

Mr. Timmons stressed the importance and the advantages of close cooperation among weed research workers, as well as between research and action agencies and research workers and commercial companies. He mentioned several research problems of an immediately practical nature, a few of which I shall mention: a development of a cropping system and rotation for the control of annual weeds; development of inexpensive methods of weed control on low valued lands; development of methods for the control or erosion during the eradication of perennials, the improvement of tillage machinery; the continuous testing of herbicides on the market to determine their relative effectiveness and the optimum dates and rates of application; the improvement of machinery for the application of dry material; more work should be done relative to the occurance of weed seeds in crop seeds and in feed grains and screenings sold for feed; the improvement of machinery for cleaning crop seeds. All of these, I believe, we have given some thought to, but we have not followed through on certain of these suggested problems. Many of these problems were touched upon by the various workers reporting at the meeting, and the importance of continuing this type of research was stressed.

The importance of continued research was brought out very clearly in Mr. L. W. Kephart's paper, "Chemical Weed Control After the War". He states that "One of the brighter aspects in the post-war weed picture is the probability that new chemical weed killers will be available of a variety and potency which we have not heretofore known. This is a refreshing prospect. Weed eradication, as a science, has always lagged far behind other kinds of pest control in the development of technical aids, and our knowledge of the nature and utilization of herbicides is crude indeed by comparison with the highly intricate knowledge of insecticides, fungicides, germicides, and the like. The reason for this is not obscure. For half a century, trained technicians by the literal hundreds have been studying chemical remedies for noxious insects and plant and animal diseases. Yet, in all that time scarcely a dozen men have had the opportunity to give their full time and thought to the possibilities of chemicals in the control of weeds. As a result, the science of chemical weed control is still elementary and farmers have had available for their use, at least until very recently, only such unimaginative materials as arsenic, chlorate, sulphuric acid, and petroleum oil. In truth, it is time for a change!"

Some of the materials which Mr. Kephart mentioned which will be in the field for further research are the sulphur compounds, the acetic acids, the aldehydes, organic peroxides, formates, oximes, chlorinated hydrocarbons, chlorinated phenols, and the dinitro compounds.

Education. Next to the importance of research, education was stressed by most everyone reporting or presenting a paper. The importance of education and the results of education, I believe, was brought out very emphatically by the State of Nebraska. They certainly have carried out a most successful educational program insofar as Bindweed is concerned. With their type of agriculture, of course, Bindweed is the most important and is deserving of the most attention. Mr. L. W. Klatt, State Weed Supervisor, in his report stated that: "Bindweed is the center of interest and the major weed problem in Nebraska. According to the 1943 Agricultural Census, over 27,000 farms report Bindweed with a total infestation approximating 400,000 acres. Ninety-six per cent of this infestation is in the eastern half of the state.

"Bindweed is costly to Nebraska. Crop losses in past years due to this pest have been millions of dollars. The year 1943 was generally recognized as a good farming year, and also one in which Bindweed would not be expected to create excessive losses, yet the estimated loss exceeds $1,960,000. This estimate was made on the basis that this weed reduced corn yields 40 per cent, wheat 25 per cent, oats 35 per cent, barley 40 per cent, and alfalfa and rye each 20 per cent."

Such losses, of course, justify their intensive educational program and Mr. Klatt states that the weed program in the State is based on education, weed eradication districts, and prevention of new infestations. The educational activities are fundamental in developing the program. I have here a few of the publications of the "Bindweed Eradicator", published by the Department of Agriculture and Inspection, Division of Noxious Weeds, of Nebraska. The Department of Agronomy of the Experiment Station of the University of Illinois carried on a similar practice. These, I believe you will agree, are very good means of education. One of the very interesting experiences which we had while more or less wandering around the streets was to note that practically anyone with whom we wished to confer, regardless of their business, was familiar with the Bindweed program. This was further exemplified by reports of the North Central Meetings appearing on the front page of the daily newspaper and receiving a great deal of space.

Control. Of course, control had a very important part in the two days of discussion, but it was very clearly brought out that effective control was brought about through research and education. I wish only to mention briefly that which I thought rather outstanding in some of these reports. Kansas, for example; the report submitted by Mr. Yost, who has been a guest of ours, presented some very interesting figures on cultivation work and complete eradication. In a five-year period, from 1939 to 1943 inclusive, he stated that Bindweed has been eradicated on an average rate of about 10,000 acres per year in this state by cultivation. The total acreage eradicated by cultivation was 49,353 acres which is 25 per cent of all reported Bindweed in this state. The total of Bindweed eradicated, including cultivation, the use of sodium chlorate, and by special methods, was 53,390 acres. These figures, I believe, bear out the fact that cultivation or any other recognized and proven eradication program can be successful if properly supervised and organized. Of the many reports, by states, which were given the first day of the meeting, practically all of the successful programs were those under district organization, such as the Nebraska program where weed eradication districts are set up as subdivisions of the state. In some states, however, this type of organization is set up by counties.

Another program was carried out by Dr. L. M. Stahler who initiated statewide tests where only two herbicides other than sodium chlorate showed any promise in Minnesota, these being ammonium sulphamate and borax. One of the interesting points in his results was that one pound of chlorate was equal to 5 pounds of borax in effectiveness on the control of bindweed. He pointed out that 20 pounds of borax showed an average survival of morning glory plants equal to 4 pounds of chlorate. He found, however, that there was a wide variation in the efficiency of either borax or chlorate alone and that recommendations of rates of applying any of these should be made with care. I mention this work primarily because, other than the extensive use made of borax in California, the work done originally by Mr. R. N. Raynor, there has not been intensive research carried on in so wide a scope as this in Minnesota.

The importance of education preceding control was brought out in a paper presented by Mr. A. K. Hepperly, Agricultural Agent of the C. B. & Q. Railroad. His paper was "Weed Eradication Problems on Non-Agricultural Lands". Mr. Hepperly showed a very keen interest for weed control and stated that, in nearly 15 years of observation of noxious weed control work in states both east and west of the Mississippi River, results similar to those received on fields which are not farmed cannot be expected on non-agricultural lands. A very practical point which he stressed, I believe is worthy of mentioning, by stating that if he had his way the Burlington Railroad would move the line fence to the bottom of the grade, thus making it possible to cultivate and farm about two-thirds of their right of way, but other departments of the railroad have good reasons for keeping the fences on the right of way line.

Mr. Hepperly's reaction relative to chlorate I also thought of interest. He stated: "I do not infer that the railroads have not killed noxious weeds with chlorate because they have, but I want to point out the results are so erratic that it requires so much labor for the original application and the follow-up treatments, and that the seedling problem, together with the fire hazard of sodium chlorate makes it fall far short of a solution to the railroads' problem of weed eradication." Considerable borax has been used on the railroad with good results, Mr. Hepperly reported, stating that inspection during the summer of 1943 showed good kill at most locations, some of which were 100 per cent. Inspection in 1944, however, showed that borax can be as erratic as sodium chlorate. Approximately 45 acres were treated at the rate of 15 pounds per square rod on some 321 different locations in Nebraska, Wyoming and Montana,

most of it being applied to Bindweed, although some on salt grass and perennial peppercress. "The report from the Roadmaster showed that on 12 per cent of the locations no kill was obtained, 3 per cent showed from 1 per cent to 24 per cent kill, 10 per cent showed from 25 per cent to 49 per cent, 33 per cent showed from 50 per cent to 74 per cent kill, 28 per cent showed from 75 per cent to 90 per cent kill, and 9 per cent showed from 90 per cent to 100 per cent kill."

Regulatory Work. Although there was a great deal said relative to laws and regulations having to do with weed control, in most instances it appeared that all the states had some type of laws and regulations but there were very few states that had the manpower and the facilities for the enforcement of such laws. Dr. F. D. Keim, Department of Agronomy, University of Nebraska, gave a paper on "What Constitutes a Good State Weed Law and Program", and from his paper I should like to briefly give you the following:

"A good noxious weed law is the backbone of a good weed eradication and control program. Just what are the advantages of such a law?

1. It furnishes the machinery and organization for action.

2. It definitely delegates responsibility and good law provides for the manpower to get the job done.

3. A good weed law must carry an appropriation large enough so that the very best type of personnel can be provided for carrying out the plans.

4. To be the most effective it must be kept out of politics. It is no place to pay political debts because trained men for this particular job should be made available and employed."

Federal cooperation was discussed briefly; although there were no definite statements made, the general opinion seemed to be that a large Federal appropriation for weed control would not be desirable. A Federal agency to cooperate with, and coordinate the work of, those states carrying weed work would be desirable, however.

I realize that this report has been a little lengthy, but at the same time, it does not start to give you all of the very interesting subjects which were presented. In closing, however, I should like to merely mention a point or two brought out by Mr. D. L. Gross, Extension Agronomist, University of Nebraska, who is Chairman of the Committee on Post-War Weed Programs. In order to carry out successfully post-war programs, the Committee agreed that the employment of one or more competent supervisors in the various weed districts to work with and advise landowners as to their noxious weed problems would greatly advance noxious weed eradication.

This, I believe, bears out the point which many of us have contended for years - that supervision is very important and that, where under some of these larger programs, public equipment and materials are incorporated in the program, such supervision is especially needed. Mr. Gross further stated, relative to the procurement of war surplus equipment, that "Since tax-supported institutions are given priority in the purchase of war surplus equipment, and since such equipment can often be purchased below market prices, it is suggested that weed district and county officials procure whatever such equipment as can be used effectively in their weed control program. This might include automobiles, or other transportation equipment, tractors, blades, fresnos, or other dirt-moving equipment, and other items. Such equipment can be used effectively in erosion

control measures to protect tillage operations." Securing this surplus equipment for use in many of the states, I think, is very important; and I believe further that we should each do everything that we can to make it possible or at least assist the various weed districts or counties in obtaining this equipment where it can be used in weed control.

Gentlemen, we have a tremendous job before us; but with 24 of the states in the Union organized for one objective, we are now in a position through cooperation to attack the job from all angles - research, education, control, regulation - and to promote more effective Federal and State Legislation.

MR. ALTON S. CRAFTS gave the following report:

HERBICIDAL PROPERTIES OF OILS

Oils are used as general contact herbicides for pre-emergence spraying in vegetable crops and for general weed killing on fence lines, roadsides, and other places where plant growth is undesirable. They are also used as selective sprays against weeds in such crops as carrots, celery, and other members of the carrot family. They are used as carriers for dinitro compounds and other phenolic herbicides. Their latest use is as carriers for the hormone weed killer, used in the control and eradication of cattails, tules, and other weeds that are difficult to wet. Finally, they are used in many horticultural sprays designed to kill insects and fungi. There is a real need for information on the toxic properties of oils as well as on their function in the spread and penetration of other pesticides.

There are several aspects to a consideration of oil toxicity. First, there are two types of toxicity, namely acute and chronic toxicity. Second, there is the question of dosage as it relates the physical properties of wetting and spreading to the chemical factors of composition. Selectivity is a third aspect. As with other herbicides, selectivity of oils entails a quantitative relation between dosage and chemical composition. Finally, there is the problem of composition as related to physiological effect. This has been studied by comparing the toxic properties of many oil fractions, and by the use of pure compounds, insofar as these have been available.

Toxicity: acute and chronic. The rapid killing of contacted tissues by oils is termed acute toxicity. It is characterized by a discoloration of the tissues, from a live green to a dead green or gray, accompanied by death. It is always manifest within a few hours after spraying and reaches a maximum within two or three days.

Chronic toxicity results in a slow yellowing of leaves, killing of the growing point tissues, particularly in grasses, deterioration, and finally death of the plant. Tissues suffering from chronic injury seem particularly susceptible to infection by fungi and often death of the plant is secondary, resulting from invasion by such parasites.

Chronic toxicity seldom appears short of a 48-hour period and in many instances shows up only after a week or more. It has never been observed after use of light fractions within the gasoline range. These compounds volatilize rapidly from the plant. Severe chronic toxicity inevitably follows spraying with heavy, unrefined or lightly treated, petroleum fractions. Some chronic toxicity results from treatment with highly refined fractions. The only heavy liquid hydrocarbon used that has not caused chronic injury is a pure sample of n-cetane.

Acute toxicity is caused by light oils and all evidence of the oil may be gone, because of evaporation, before the injury appears. Since, with two fractions such as gasoline and diesel oil, the former produces only acute toxicity whereas the latter displays mainly chronic toxicity, it seems evident that boiling range or density must be an important factor in determining toxicity type. Unsulphonatable residues from two such fractions have much lower toxicities and two aliphatic compounds of comparable boiling range, i.e. isoctane and n-cetane, are devoid of toxicity. Consequently, the unsaturates composed chiefly of olefins and aromatic compounds must be the main toxic ingredients, and the type of toxicity must be related to the composition of the unsaturate fractions as determined by boiling range. Acute toxicity results from low boiling olefinic and aromatic compounds; chronic toxicity from high boiling ones. Evidence from experiments with pure compounds substantiates this conclusion.

Acute toxicity is dependent on a relatively high concentration of unsaturated materials. Gasoline has an unsulphonatable fraction of around 70%; that is, the unsaturates may make up about 30% of the gasoline. If such a fraction is diluted with an equal part of non-toxic oil, acute toxicity of the mixture is very much reduced. If the unsaturate concentration drops much below 10 per cent, the mixture becomes relatively non-toxic.

The appearance of chronic toxicity after spraying with such oils as odorless kerosene, Shell mineral seal, and even a synthetic heavy isoparaffinic oil indicates that the actual toxicant must be present in low concentration, for these are all highly refined oils. The presence of chronic toxicity on foxtail, over and above that caused by the diluent when the highly aromatic tar oil "pure still residue" from the Barrett Company was used in as low concentration as 1 part in 128, again indicates that the chronic toxicant is highly effective. Furthermore, the shift of the tropic response of barley seedlings from negatively to positively geotropic when heavy oils are used indicates a possible hormone-like activity for such oils.

Dosage and coverage. As with other herbicides, dosage of oils is important. The low viscosity and high wetting power of oils on plant surfaces make for a ready coverage when pure oils are used. These properties may be approached in an emulsion but are never quite met because of the differences in interfacial tensions between the plant cuticle and an aqueous film as compared with oil. For this reason, no matter how readily an emulsion may wet a plant, any excess volume of solution, above that required for the wetting film, tends to accumulate in drops and fall off, whereas oils tend to run and creep, adhering strongly to plant surfaces.

Ideally, the toxicity of a good herbicide should be such that when the plant is completely wet the film should carry enough toxicant to cause death. With such a herbicide, dosage would be determined by the thickness of the film that would adhere to the plant, and by the area of surface to be covered.

Practically, it is impossible to cover the whole surface of all weeds in many situations. To kill such weeds it is necessary that the toxicant either translocate within the plant after absorption, or creep along the surface and kill by contact. Experiments show that the excellent results obtained with diesel oil in roadside spraying depend upon the movement of the oil along the plant surface, often for several inches. Diesel oil is not highly toxic; however, being heavy, it persists on the plant; it adheres to the surface and creeps downward into the crowns of grasses; its toxicant properties are such that it penetrates and kills meristems, preventing regrowth.

Dosage tests with diesel oil showed that, for a given type of barley culture, 10 ml. of diesel oil would kill all of the plants in 11 days; 20 ml. killed all in 3 days. The 10 ml. dosage did not provide a coating all over the plants but the oil ran down the stems into the crowns, resulting in chronic killing. With gasoline, evaporation is so rapid that only contacted tissues are injured; these die within 24 hours.

For reasons obvious from the above discussion, gasoline must be applied at such a dosage that all tissue to be killed is contacted. With diesel oil, if the upper half of the plant is sprayed and sufficient volume of oil is applied for downward creeping, the plants will untimately die. This is the reason for the wide success from the use of diesel oil in general contact spraying of weeds.

With an emulsion of dinitro compounds in oil an entirely different dosage-concentration relation exists. Such emulsions are highly toxic, often carrying many times the total toxicity of diesel oil. However, because the emulsions will not creep down the stems into the crowns of grasses, thorough wetting is required to prevent resprouting from unkilled crowns. Increasing concentration in such a situation is of little avail. To make the treatment more effective more volume must be applied, and increasing the wetting through addition of wetting agent and increase of pressure help. Another expedient is to wait until grass crowns are mature and through tillering; such plants, if thoroughly sprayed, will not resprout.

For reasons cited, light oils must be applied so that all tissues to be killed are contacted; dosage of heavier oils should be sufficient to wet all tissues but coverage need not be so complete; with emulsions all tissue should be wet and the concentration should be such that all contacted tissue is killed by the amount of toxicant held in the wetting film.

Toxicity of highly aromatic oils such as Edeleanu extract, Avon weed killer, tar oils, and still residues from coal distillation may greatly exceed the required level. It would seem economical to use such materials in a diesel oil base for the compounding of contact herbicides. They would have the distinct advantage of being toxic to all vegetation, including several species such as fennel, groundsel, pineapple weed, star thistle, etc. that normally tolerate diesel oil.

Selectivity. Probably the most outstanding case of selectivity of herbicides is that of light oil fractions on carrots and other members of the carrot family. These species tolerate dosages of oils that are fatal to annual grasses and most broad-leaved weeds. Selectivity is greatest with light oil fractions in the boiling range of 150°C to 225°C; lighter oils are volatile, evaporating before injury occurs; heavier oils cause chronic toxicity that is injurious to carrots.

Experiments with purified fractions and pure compounds prove that the olefinic and aromatic compounds are the ones causing toxicity to weeds without killing carrots. Selective toxicity increased through the series benzene, toluene, xylene; and the unsaturates in gasoline kill selectively at a much lower concentration than does xylene. When samples labeled heavy olefins and heavy aromatics were used with n-cetane as a diluent, both were selectively toxic to grasses with the aromatics being the more toxic of the two. There were indications that the olefins were somewhat more selective but this will need confirmation.

Selective killing of grasses in onions and flax has also been observed in the greenhouse. This was first found when gasoline diluted with odorless kerosene

or with a relative pure isoparaffinic fraction was used. At certain dosage rates the gasoline possessed acute toxicity that severely injured the grass without hurting flax and onions. The grasses failed to recover, probably due to the chronic effects of the diluent, and a complete selectivity resulted. More recently grasses have been killed with kerosene with little injury to flax and onions. One instance was noted where cultures of mustard and barley sprayed with an isoparaffinic fraction responded by death of the barley with no injury to the mustard. This type of action deserves further study.

Concerning the tolerance of crop species to oils, carrots are probably the outstanding crop. In addition, celery, parsley, parsnip, dill, and caraway show little injury from oil sprays. Coriander exhibits yellowing of the lower leaves but no permanent injury. Anise is less tolerant, showing serious injury from stove oil. Guayule will tolerate low dosages of diesel oil.

Of the common weeds, sweet fennel and poison hemlock are highly tolerant of oils; pineapple weed and groundsel are only partially injured, and purslane and star thistle may escape serious damage.

Small weeds are always less tolerant of oils than large ones; in fact, one receives the impression that large mature stems of most weeds are very resistant to oil injury.

Composition. Studies on the relation of chemical composition of oils to their toxicity have involved several methods. One has been to compare different oil samples as they were obtained from the refineries; another has been to fractionate and extract oil samples and test the various fractions and extracts for toxicity; a third method has been to compare natural or synthetic oil fractions with pure compounds in an attempt to replicate the symptoms of oil injury.

One of the early experiments compared four samples of stove oil obtained from four different distributors but complying with similar specifications. These were found to be equal in toxicity which answers a query often asked by growers. A recent test on two stove oil samples that had been used in the field at Salinas proved that one was definitely toxic to carrots while the other was not. Studies on the oils proved that the toxic sample had a UR of 73.9, the non-toxic of 77.9. Their gravities in API units were 34.7 and 38.7, respectively. The toxic oil did not meet stove oil specifications, being somewhat heavy. The toxicity tests in the greenhouse substantiated field experience with this oil.

Many tests have been run on oil samples and the following statements cover some of the points established.

Gasoline is high in acute toxicity, lacking in chronic toxicity. It is more selective against weeds in carrots than is stove oil. Cracked gasoline is more toxic than straight-run.

Kerosene, being solvent extracted, is lacking in acute toxicity but retains a low degree of chronic toxicity. This may be sufficient to kill grasses, particularly young barley seedlings.

Odorless kerosene is acid treated in addition to solvent extracted. Its chronic toxicity is lower than that of ordinary kerosene. Its toxicity increased upon standing; more in a clear bottle than in a brown one.

Stove oil has both acute and chronic toxicity. It is just on the borderline with respect to chronic injury to carrots. As noted above, a drop of 4 points in gravity will render it toxic enough to be objectionable in the field.

Diesel fuel is low in acute toxicity; intermediate in chronic toxicity. Its low volatility enables it to remain on the tissues long enough to make full use of what chronic toxicity it has.

Edeleanu extract is very high in acute toxicity. It also undoubtedly has chronic toxicity but this is masked by the acute injury.

Avon weed killer, a crude residue remaining after distilling technical toluene and other solvents from Edeleanu extract, is extremely high in both acute and chronic toxicity. In fact, it could be diluted with diesel oil to provide a herbicide of desirable characteristics.

U. S. number 1 fuel oil, a black, heavy furnace fuel, showed little acute toxicity, and even chronic toxicity developed slowly. This oil was too heavy to spread readily and proved more toxic when diluted with 3 parts of odorless kerosene than when applied pure.

A number of other oils have been tested, including a gas drip oil of very low toxicity, two distillates from the reconditioning of used crank case oil that were comparable with stove oil, and a black journal box oil similar to the U. S. number 1 in physical properties and toxicity.

Studies made on unsulphonatable residues and temperature cuts of several oil fractions showed approximately which compounds were responsible for toxicity. The first tests (temperature cuts) showed that in stove oil and diesel oil the heavy ends were the most toxic. That this toxicity was chronic was shown by the fact that whereas the toxicity after 48 hours was greatest for the light ends, 4 days later the results were reversed and toxicity was greatest for the heavy fractions.

Toxicity tests on the unsulphonatable residues of stove oil and diesel fuel proved that whereas that of diesel oil was non-toxic within the period tested, that of stove oil was toxic, and the most toxic fraction was recovered from the light end of the stove oil. This was confirmed by a retest on a second set of stove oil fractions.

Edeleanu extract (boiling range 190° to 260°C) proved highly toxic to carrots as well as weeds, and temperature cuts of this material proved that the greatest toxicity lay at the heavy end. Successive SO_2 extracts had reducing toxicities as might be expected. Tests with Edeleanu extract and Avon weed killer in various concentrations in odorless kerosene proved that these highly aromatic fractions are toxic to all plants, including carrots, at high concentration, but when diluted selectivity enters and results similar to those with gasoline and stove oil are found. This proves that selectivity of oils is relative; at high concentrations the toxic olefinic and aromatic compounds kill all species, at lower concentrations they are tolerated by members of the carrot family and some other plants. By altering the proportion of these compounds to aliphatic hydrocarbons in an oil the volume of oil that wets the plant may be adjusted to contain just enough toxicant to kill the weeds and not enough to injure the crop. If the oil is sufficiently volatile it will evaporate and injury will not develop with time. However, although the proportion of toxicant to carrier in an oil is correct to give good selectivity, if the toxicant is heavy enough to persist with little loss, then chronic injury will occur in time and the crop will suffer. This relation explains why gasoline can be used in excess with no injury to carrots, stove oil must be limited in dosage, and almost any amount of diesel oil will injure the crop.

Studies with pure compounds, to the extent that they were available, were undertaken to confirm the results obtained from oil fractions. Three samples of saturated hydrocarbons, n-hexane, n-cetane, and isooctane proved non-toxic to all plants. It is hoped that these materials will be available in larger quantities for use as diluents in subsequent work. Samples of relatively pure isoparaffins, both light and heavy, were also practically non-toxic; after storage for some months appreciable toxicity was found when these were retested. No pure olefins have been tested but the toxicity of such compounds has been confirmed by comparative tests on straight run and cracked gasolines, and also by examination of a relatively heavy, high olefin oil fraction.

Unfortunately, a sufficient number of pure aromatic hydrocarbons having a boiling point comparable with various oil fractions has not been available. Those tested included benzene, toluene, xylene, ethyl benzene, cumene, cymene, diisopropylbenzene, triisopropylbenzene, and tetraisopropylbenzene. The results were in the main as anticipated but the toxicities, when the substances were diluted with a relatively non-toxic solvent, were somewhat less than that of the oil of corresponding boiling range having about the same aromatic content. Other significant variations are being studied further. Three compounds having saturated ring structures, methyl cyclopentane, cyclohexane, and methyl cyclohexane, were tested; all showed little acute toxicity, thus confirming the low toxicity of napthene fractions of oil.

Propyl and butyl mercaptons caused acute toxicity only at high concentrations. A sample of high sulphur gasoline supplied to us was very toxic. A sample labeled naphthone A, which had a high acid number, was also tested and proved to be very toxic.

Many other aspects have been investigated. For example, ageing for a year or more, especially with light, increases the toxicity of gasoline, kerosene, and relatively pure isoparaffinic fractions but had no effect on stove oil or diesel oil. The same effect, even to some extent with stove oil, was apparent in samples that had been refluxed for several hours with air. These studies are being continued.

The following committees were appointed:

RESOLUTION COMMITTEE	NOMINATION COMMITTEE	1946 PROGRAM AND MEETING PLACE
B. E. Kuhns	Geo. Hersley	R. J. Evans
E. J. Ward	Lambert Erickson	J. B. Holladay
H. E. Morris	Victor P. Rasmussen	W. W. Robbins

The meeting adjourned until 1:30 P. M.

Wednesday, June 6th
Afternoon Session

Meeting was called to order at 1:40 P.M. by Chairman Burge.

MR. WHITE (U.S. Indian Service - Utah): Mr. Chairman and members of the conference, as I recall it has been about 23 years since I attended my first weed conference here in Boise. I came here as a listener and these few extemporaneous remarks that I might make, I am sure, will not be of any benefit to you. So far I have been more than paid for my trip to Boise. I have enjoyed the remarks by the two gentlemen, Mr. Ball and Dr. Crafts, and looking over the program I see some fine topics for discussion. The region I am interested in is Region VII, which takes in part of California, New Mexico, Utah, Idaho, and part of Arizona. I believe from talking with you today that our problems are largely similar to problems that you have, altho we may have some complications you don't have. Anyway, we have some weeds. Our problems are with Indian farmers. There are Indians who own their land; others are lessees and there are a number of white lessees. We do have a great many problems with these people. We are interested in their food supply, in their irrigation supply and so forth. Our problems are interwoven with the county and state problems. Your help is needed, for we are very much interested in the cooperative work of the county weed supervisors and state officials. I want to assure you that the Indian Service will cooperate 100 per cent. In Idaho, there is Indian land in several counties in the Southern part of the state, --Bingham and Bannock; Elko, Clark, and Story Counties in Nevada; Uintah, Duchesne, and Tooele Counties in Utah. The weed situation is in its infancy in so far as control measures are concerned. We are working along the same lines as you county weed supervisors. We are aware of the seriousness of this problem and are cognizant of the importance that should be attached to it. We must conserve our agricultural lands. The represent more wealth than any other one thing. I think we weed people look at it as a community problem. Originally it was considered the farmer's problem because it was thought that he derived all the benefits from it. Now we see things differently, for people other than farmers derive profits from it, so why shouldn't they help with the situation. I think the time is here when we should realize the weed problem as a community problem, not the farmer's. I want to say this, however, that in our work we recognize that we do have a problem and that we need the cooperation and help of all you people and in turn we want to work with you 100 per cent, as I said before. Our Reservations are under the direction of the Supervisor, but wherever they are located we try to work through the local people and in turn cooperate with their Supervisors and the State organizations. I enjoy working with you people and I know I am going to get a great deal out of this program.

MR. BURGE: Do you have money earmarked for weed control?

MR. WHITE: Yes, we do.

MR. BURGE: Is it sufficient and adequate or should there be further effort made to get more?

MR. WHITE: We have never had enough to handle our weed problem and we would certainly appreciate help from the state.

MR. A. B. BALCOM, gave the following report on the Control of Waterweeds in Irrigation Systems.

> Mr. Chairman, members and fiends of the Western Weed Control Conference. The Bureau of Reclamation is glad to participate in your meetings because they have

afforded it an opportunity to keep advised concerning the latest developments in the control of land weeds which create troublesome problems on both irrigated farms and ditchbanks.

I have been asked to talk to you today on the subect "The Control of Waterweeds in Irrigation Systems," which is one of the most important weed problems connected with operating irrigation projects.

Early irrigation in the United States was, for the most part, confined to diverting water directly from natural streams. When these carried sufficient silt, the growth of water plants was inhibited. When simple diversions were no longer adequate, it became necessary to build dams to impound the water supply. The reservoirs thus formed act as settling basins and the water coming from them is comparatively clear.

Because of this and perhaps other influencing factors, the control of waterweeds has become increasingly difficult in many irrigation systems, both Federal and private. This condition has come to the attention of most of you weed control leaders in the irrigated West because you have been called upon more often during the past few years to give advice on solving the problem. This demand has been stimulated because of the increased spread of aquatic vegetation, because people are in general becoming more weed conscious, and because many feel that scientific research will prove of value in finding more efficient methods of controlling waterweeds as it has landweeds.

In some areas the control of weed growths in irrigation distribution and drainage channels have been considered to be a private problem of the irrigation district involved. However, waterweeds are just as much a part of the weed program of irrigation farms as the weeds growing on cropland because the districts are comprised of groups of farmers who must pay the costs of providing control measures.

Waterweeds are usually spread by the water itself. Often, rivers, lakes, and reservoirs which furnish water to a project are infested with waterweeds and they provide the seeds and pieces of plants which float down to infest the irrigation system. The growths are more prevalent in some areas than in others. Clear water, slow velocity ditches, long, hot growing seasons, and an uninterrupted flow of water in the ditches during the entire 12 months of the year intensify the infestation.

Waterweeds seriously reduce the efficiency of irrigation systems. What is most important is that heavy infestations reduce canal capacity thereby making it difficult to furnish sufficient irrigation water to the project farms. When control steps cannot be taken in time, low yield and low quality of crops may result. Because of their desilting action, these growths build up silt bars in the channel which further reduce the canal capacity and necessitate costly dredging. Also, as the water cuts around the silt bars, extensive erosion of canal banks and beds often occurs. Weeds cause ditchbreaks by retarding the flow of the water until it overflows the banks, which results in delays in service and repairs as well as damage to crops by flooding and the loss of water so vital to irrigated areas. A large amount of water is lost each year through transpiration of cattails, tules, and other emergent plants. When the water is raised above the normal flow line by weed growths, the amount lost in transit due to seepage is increased. Structures are often clogged, causing interruption in water delivery and additional costs in clearing the congestion. When drains become congested with aquatic plants and the silt which they cause to be deposited, their efficiency is seriously impaired and alkaline and seeped conditions on farm land result.

The Bureau in its study of the waterweed problem has segregated them into three types - floating, emergent, and submersed - because early tests indicated that each of these may require different control methods. While in some instances certain kinds of weeds in one group respond better to a certain method than other plants in the same group, the general method for each type is considered quite similar.

The floating weeds have given the least trouble. The larger plants found on Bureau projects are: water lettuce (Pistia Stratiotes) and water hyacinth (Eichornia crassipes). Two other very small plants - floating duckweed (Lemna species) and water velvet (Azolla species) are often present but are troublesome only if their mass adds to a congestion in a culvert or other closed water conveyance.

The emergent waterweeds are generally more prevalent in drains than in canals and laterals. The most troublesome in this group are cattails (Typha species), tules (Scirpus species), parrot feather (Myriophyllum proserpinacoides), water primrose (Jussiaea species), and water cress (Nasturtium species).

The submersed weeds are by far the most important group because they are more widely distributed and are found in both distribution ditches and drains. The troublesome member of the unattached submersed plants is the coontail, known sometimes as hornwort (Ceratophyllum demersum). The most prevalent attached plants of this type are the pondweeds (potamogeton species), horned pondweed (Zanachellia palustris), water milfoil (Myriophyllum species), waterweed (Anacharis canadensis), water buttercup (Ranunculus species), spiney naiad (Najas marina), yellow stargrass (Heteranthera dubia) and muskgrass, usually called by its botanical name Chara. Algae are usually placed in this group but some kinds may be floating and unattached until they become tangled with rooted plants.

Several methods have been used to control waterweeds in irrigation systems. These fall into three main classes - mechanical, drying, and chemical. A fourth-shading - has been used but is not readily adaptable.

The floating weeds are being largely eliminated by mechanical means. When water lettuce plants begin to pile up behind a check or other structure they are raked or forked to the bank. In some instances a wire netting screen is placed across the channel to collect the plants which are then conveyed to the banks. On the only Federal project where water hyacinths occur, they have been kept from the canal system by a log boom and screens at the headworks.

Floating plants adapt themselves readily to chemical control and if they become increasingly prevalent this method will be more thoroughly investigated. It has been demonstrated that Benoclor will kill water lettuce, and initial tests with oil have given fair results. It is possible that one or more of the new contact herbicides may prove effective. Floating plants have been controlled with chemicals containing arsenic, but unless applied with extreme caution poisons would be dangerous in irrigation systems.

The rooted emergent plants, as a whole, have persistently resisted efforts of economic control. Both mechanical and chemical methods have been used. The so called "drowning" method is often employed for cattails which are by far the most numerous and widely spread of the plants in this group. When they are cut off under water several times during their growing season they weaken and die. The number of cuttings required depends on the depth of the water above the stumps. Evidently, when the roots are unable to obtain air through the leaves

for some time, the food reserves ferment and this, together with carbohydrate starvation, causes the plants to die. Several attempts have been made, with various degrees of success, to devise power sickles for cutting cattails under the water. In most cases the work is done with hand tools.

While chaining submersed weeds in canals on one project - which will be discussed later - it was noted that the few cattails present disappeared entirely. For the past two years this project has chained some of its drains once or twice a year and has almost eradicated the cattails in those areas. The chaining mashes the plants into the silt at the bottom of the drain. The most widely used method for cattail control is dredging with draglines after the drain has been partially filled with silt and plants. Continued burning will also decrease the cattail population and eventually kill the infestation.

Test treatments with chemicals on emergent waterweeds have included pentachlorphenol, sodium pentachlorphenate, ammonium sulfamate, sulfamic acid, sodium arsenite, sodium chlorate, copper sulfate, and chloronated benzenes. No difficulty has been encountered in killing the growth above the water surface on most emergent plants with many of these chemicals. However, except for treatments with chloronated benzenes, known commercially as Benoclor, the growth below the water remained alive and generally within a few days the plants were again above the surface. The pentachlorphenols have shown a distinct retarding of parrot feather regrowth. When Benoclor was sprayed at the rate of one gallon per square rod directly over parrot feather plants so that the tops were thoroughly saturated and the remainder of the chemical went into the water, excellent control was obtained. In most cases the plants never regrew. Cattails and tules have been killed if cut beneath the surface and Benoclor applied to the water within a few hours. In tests conducted by the Bureau, the most satisfactory control of water cress was obtained by spraying a saturated solution of copper sulfate, at the rate of 3 gallons per square rod, over the plant beds. A definite need exists for a more economical method of controlling emergent waterweeds, particularly cattails, in irrigation systems.

Of the submersed waterweeds the Potamogeton or pondweed species are the most widespread, are among the most difficult to kill, and in general create the greatest problems. All four of the control methods previously mentioned - drying, mechanical elimination, shading, and chemical - are being employed.

Shutting off the water in the ditch and allowing it to drain and the weed growth to dry out is perhaps the most economical method now known for controlling submersed aquatics. The effectiveness of this method is dependent on how quickly and completely the water will drain from the channel and on weather conditions immediately following. Usually 3 or 4 days of hot weather and sunshine are sufficient to kill the stem and leaf system of the plants. This process may have to be repeated several times during the season because the roots are not killed and regrowth, particularly during hot weather, it quite rapid. Flat ditches with uneven bottoms are difficult to drain and the weeds growing in low spots which hold the water remain alive. The ditch, of course, is out of service during the "cut out" period which often coincides with the time of greatest demand for irrigation water. However, where this method has been used, the farmers have become accustomed to the water "cut outs" and have learned to plan their irrigation in advance. In a few districts officials became familiar with the efficiency of this method of controlling weeds when water was turned out of a ditch for other reasons. They noted how growth of the infestation was retarded and since then they have used the method wherever possible. In some of the larger canals the drying may not always be practical and it cannot be used in

drains or ditches which pick up drain water for redistribution.

At present mechanical means of eliminating submersed aquatic weeds is the most common. On a few projects where the capacity of a ditch permits sufficient flow even when weeds are present nothing is done until the desilting action of the plants has partially filled the channel. When this occurs dredging with draglines or Ruth dredgers is necessary to remove the growth and silt. While this removes many of the tubers and roots and retards the regrowth, it also enlarges the cross section of the ditch, and is a very costly operation. When it is necessary to maintain a ditch road to facilitate future ditchbank weed control, and for other purposes, a grader must be used to level the material removed from the sides and bottom of the channel. Until chemicals were adapted to waterweed control, dredging with machines or cleaning with hand tools were the only methods available for inaccessible drains and ditches.

Chaining submersed waterweeds is the most popular control method where it can be used. Usually a heavy ship anchor chain, weighing about 30 pounds per lineal foot, is employed. Each end is attached to a tractor, truck, or team on the opposite banks. The equipment moves slowly along the banks with the chain following in the bottom of the channel in a long curve. From one to three round trips are required to break the weeds loose, the number of trips depending on the kind of weed, density of infestation, and the stage of the weeds' growth. The best success is obtained when the plants are fairly well matured because the stems are then more brittle and break off more easily.

In areas of cooler climate, one or two chaining operations per season are often sufficient. However, in some ditches which are heavily infested, four or five operations may be required. July and August are the chaining months on the northern projects. In the south, where the growing season is longer and particularly on those projects where water flows in ditches the entire year, chaining may be a monthly process from April through October.

Some projects have found that special discs attached to the chain help cut the weeds loose, especially when the "demossing" must be done before the plants are mature. The discs also destroy many of the tubers in the silt and increase the turbidity of the water, both of which retard regrowth. Discs are not used in channels constructed through soils which without a protective silt covering would have a tendency to leak. As the plants are broken loose they rise and float with the current. Racks are conveniently placed to catch the plants, and on large canals crews of 20 men or more are required to fork the collected material to the banks.

Chaining is dependent on suitable roads being available on both banks of the channel. The cost of the operation is increased considerably where many bridges or other structures are encountered and the efficiency is decreased because the chain cannot dislodge the weeds near the structures. Chaining loosens rock riprap and is often injurious to concrete linings. It also spreads the weed infestation because many of the seeds and pieces of the plants will escape through the rack, lodge further down the channel, and grow. Chara cannot be successfully chained because it does not come to the surface and both Chara and Anacharis, or waterweed, rolls up on the chain.

Many other types of equipment such as weed saws, underwater sickles, special discs, canal rakes, ditch dozers, weed forks, and harrows have been developed but most of these are used only in sections of ditches which present special problems. Some are operated from the banks and others from rafts and boats.

As most of the submersed plants require considerable light for their development, turbid water will inhibit their growth. Advantage has been taken of this where possible in controlling submersed aquatics. A few projects have introduced clay into the water to seal leaky ditches with a coating of silt and at the same time reduce weed growth. Others have devised ways of flushing silt-laden reservoirs or canals at the appropriate time to accomplish this purpose. However, in the majority of cases, this method cannot be adapted to general use. If the ditches so treated do not have sufficient velocity to carry the silt through, undesirable deposits will collect in the channel.

Many chemicals have been tried for controlling submersed waterweeds. Sodium arsenite or other arsenic compounds and copper sulfate have, perhaps, until the introduction of Benoclor, been the most effective. Arsenic has been reported as being quite successful in small lakes but there is a decided hesitancy to use such a strong poison in an irrigation system. Copper sulfate has long been used for controlling Algae but so far it has not proved satisfactory on higher types of plants. In alkaline waters high in carbonates, the copper sulfate must be introduced at short intervals because the chemical quickly precipitates out as a basic copper carbonate. Tests made last year with copper sulfate gave some indications of retarding the growth of pondweed but so far we can only recommend this chemical for Algae control. In sections of a ditch which cannot be chained, such as areas near structures, a heavy application of sodium chlorate to the soil in the bottom and sides of the ditch when dry gave satisfactory control. However, the cost would make the method prohibitive for other than small areas.

The most recent development in chemicals for controlling submersed waterweeds, and by far the most successful, is the chlorinated benzene known as Benoclor. It is a heavy non-soluable liquid which has been used for several years in the East to reduce waterweeds in lakes and ponds for the improvement of boating, fishing, and swimming. It was introduced to irrigation about 3 years ago and since then numerous tests have been conducted in close cooperation with the research engineer of the manufacturer. Inasmuch as this is the newest waterweed control method and it has created much interest among weed leaders, a more detailed account will be given.

Tests were first conducted to determine if crop plants would be injured when irrigated with Benoclor-treated water. It was found that several times the strength of the concentration used for controlling waterweeds was necessary before even a slight injury was sustained. No ill effects have been reported where the chemical has been used extensively but precautions are being taken to prevent it from reaching crop land. Turnouts along the section of ditch being treated are closed while the chemical blanket is flowing past. Where possible the treated water is turned into a wasteway and where these are not available the turnouts for about a mile past the end of the treated area are closed.

Recent tests by the Bureau of Animal Industry have disclosed that a mixture of 6,000 cc. of Benoclor and water with a Benoclor concentration of about 17,000 parts per million is required to cause death. This concentration is many times greater than used for waterweed control.

In cooler climates Benoclor is usually applied during July or August when the waterweeds begin to hinder the flow of water. Often one to two applications are sufficient to keep the growth in control and allow a ditch to carry the required amount of water. When treatments must be started earlier in the season more applications may be necessary. In warmer climates, control may be needed in April or even sooner.

Each treatment adds to our knowledge of how to apply Benoclor because in most cases complete records are kept of applications made and the results obtained. The amount of the chemical required depends on the density of the weed growth, the type of weeds present, and the size of the ditch. The density of growth is difficult to judge, and this has made it impossible to give more definite recommendations on dosages.

We know that Chara and waterweed can be killed with less chemical than the pondweed. Further studies are needed to determine the concentrations necessary for killing each kind of aquatic growth, the contact time required and the concentration of chemical present at any desired place along the ditch. It is hoped that these studies, which are planned for this year, can be successfully culminated so that more accurate recommendations can be given. This would lead to the saving of chemical, because when too little is applied the work is not satisfactory, and when more than sufficient to kill the weeds is used, the excess is wasted.

However, with certain established procedures in the use of Benoclor, many irrigation districts have been able to control their waterweed growths more efficiently than by their previous methods. It has been of particular value during the present labor shortage. Instead of a crew of possibly 25 workmen being necessary, as in chaining and hand methods, the waterweed growths in an entire irrigation system can be controlled with Benoclor by 2 men.

Benoclor 3, the first of the chloronated benzenes used, does not form a stable emulsion. It is used in lakes and ponds where it is desirous to have the chemical settle down over the plant beds. It is sometimes used for static water treatments in irrigation ditches and drains where the flow can be stopped. In static water the chemical is applied from a truck driven slowly along the bank. The nozzles are placed 2 to 4 inches under the surface of the water and the chemical sprayed directly into it until the entire area to be treated has been covered. This method generally requires from 20 to 30 gallons of Benoclor per acre of water surface. More chemical is used in static treatments but there are some indications that a more complete kill results and regrowth is much slower where this method can be adopted.

Emulsifying agents used in Benoclor 3-Special makes it form a more stable emulsion and it can be applied in a flowing stream. In order to save chemical, the general practice when using this formulation is to reduce the volume of flow to the minimum amount necessary to cover the weeds. This operation also reduces the velocity which gives the emulsion a longer contact period with the weeds. Where possible the treatment is started a few hundred feet above the beginning of the infestation to assure that the chemical is completely mixed with the water before it reaches the plants.

Any hand or mechanical pump which will deliver the chemical under pressure may be used. For ditches up to 10 feet wide one nozzle is usually sufficient. For wider ditches a battery of nozzles may be used. The pressure and size of the opening in the nozzle disc regulates the rate of application. Benoclor is a solvent of natural rubber making it necessary to employ a synthetic rubber hose.

A convenient structure or a plank across the ditch may serve as a platform from which to work. As in static applications, the nozzle is placed under the water but in this case the water is the carrying agent. If only one nozzle is used the spray pipe is moved back and forth across the ditch. The total amount to be sprayed at the first station is applied continuously over a period of an hour so that the chemical blanket will be in contact with the plants for this length

of time. In general, the amount applied at the first station for pondweeds has been 3/4 to 1 gallon per foot of water surface width. When the initial application is completed, the work crew follows the chemical blanket down the ditch to determine the second point of application. This location will depend on the amount of chemical which has been absorbed by the plants and lost through breaking of the emulsion, which usually averages 1,200 to 1,400 feet from the first station. At present visual observation is the only method of determining the remaining strength of the concentration. When the blanket begins to weaken it loses its brilliant white color and takes on a bluish cast. When this change is observed sufficient Benoclor to bring back the original concentration is sprayed into the original blanket as it passes. The application at this point does not usually exceed $\frac{1}{3}$ gallon per foot of water surface width. If additional stations are necessary their location is determined in the same manner as the second station. The last application is usually made from $\frac{1}{4}$ to $\frac{1}{2}$ mile above the end of the infestation. Benoclor 3-Special is also often used in static water treatments.

A new formulation - Benoclor 3-C - has recently been introduced. It forms a more stable emulsion than Benoclor 3-Special and initial tests have indicated that it is more efficient than the other Benoclors in flowing water. Benoclor 3-C has carried as far as one mile and still held its emulsion. The cause of failure to make a complete kill beyond that point is believed to be due to the plants absorbing most of the chemical applied. In many cases it may be possible to apply at one station all or most of the dosage required for controlling the entire length of infested area. Benoclor 3-C should be more economical to use because losses through the breaking of the emulsion will be reduced and because less labor will be required.

Accurate costs of individual Benoclor treatments cannot be given because nearly every ditch presents a special case. However, on one project where 300 miles of ditches were treated in 1944, the average cost per treatment was $35.00 per mile. The average width of the water surface was twelve feet.

In most instances the capacity of a treated ditch is restored within 24 hours. Pondweed plants turn brown, become limp and lie flat on the bottom of the ditch where they slowly disintegrate. The leaves and stems break loose in such small pieces that they cause no congestion of irrigation structures. Regrowth of the plants are much slower after Benoclor treatments than after chaining. There are some indications that the regrowth is also less dense after each treatment.

Without a doubt, Benoclor has a place in waterweed control. It is easy to apply, restores channel capacity quickly, requires little labor, and it can be used where other methods are not adaptable, such as in ditches not provided with ditch-bank roads. Even in the early stages of its development it has proved more economical and efficient than many of the other methods.

It is quite possible that scientific research will bring forth an even more effective chemical, one which will follow down into the root system of the waterweeds and kill the entire plant, as do the new "harmones" on land weeds. It will be interesting to see how 2,4-D will effect water plants.

Aquatic plants create an enormous problem in some irrigation systems. The importance of waterweed control is reflected by the numerous methods which have been tried in an attempt to solve the problem. Each ditch system and in some cases each ditch must be studied to determine the best method or combination of methods to use.

As it becomes more fully realized how important waterweed control is to irrigation agriculture, it is certain that more scientific research will be undertaken. The Western Weed Control Conference can by its support help increase the interest in such a program.

The president introduced Dr. McCall, U.S.D.A. Bureau of Plant Industry, Soils & Agricultural Engineering.

MR. McCALL: I am very glad to be here and have the opportunity to hear this paper and if I had time would stay and hear more. We are intently interested in this weed problem and honestly wish we had more resources to put into work. An effort should be made for more research work, and I want to assure you that we will do everything we can.

MR. BALL: Would it be asking too much if we would ask for cooperation through your department to assist Forest Service and the other departments in Washington to get budget increases for weed control of Federally owned or controlled lands?

MR. McCALL: No, it would not.

MR. BURGE: Last year as part of our Nevada report, I made a few remarks on halogeton. It is annual topic for discussion. At the time I made the statement that this plant was spreading by leaps and bounds. It spread over a large part of the eastern boundaries of our State and into adjoining States. Since that time, we have conducted our survey and found that the spread has been even more rapid than we anticipated at that time. I had occasion to see some individual plants, spaced five to six or ten feet apart. At the present time the seedlings under those plants are as solid as an alfalfa field would appear after planting. Incidentally, we have had as high as 100 per cent germination in twenty-four hours. Our chemist was supposed to give us some figures on the chemical content of this plant but unfortunately after attending a conference in Las Vegas, he became ill. We are very fortunate, however, in getting Mr. Douglas of the Bureau of Entomology and Plant Quarantine who is working on this particular plant as a host to the white fly, as it is of much interest to the people in the soy bean and tomato industry. He came up from Twin Falls, for this meeting, so at this time I would like to call on Mr. Douglas.

MR. J. R. DOUGLAS gave the following report on "Beet Leaf Hopper and its Relation to Halogeton".

Since halogeton (Halogeton glomeratus (M. Bieb.) C. A. Mey.) is closely related to Russian thistle (Salsola kali var. tenuifolia Tausch), an excellent summer host of the beet leafhopper (Eutettix tenellus (Bak.)), studies were undertaken early in the season of 1943 to determine the suitability of this comparatively new introduced weed as a host of this leafhopper. Preliminary cage tests under both field and greenhouse conditions showed that the beet leafhopper would breed on this weed.

In order to obtain definite data on the reproduction of the beet leafhopper on halogeton, preliminary cage tests were conducted. As an example, in a field test 10 female beet leafhoppers were introduced on May 18, 1943, into a cage that covered 0.625 square foot of soil surface containing halogeton and were removed on May 29. Their progenies were counted on September 27. The reproduction on this weed host during the 132-day period was 357, or at the rate of 572 leafhoppers per square foot of soil surface occupied by the weed host. In the greenhouse 50 female beet leafhoppers were introduced on June 14, 1943 into a cage that covered 6.25 square feet of soil surface containing 9 comparatively small halogeton plants. These females were removed on June 25. The progenies

of these females were counted during the period September 27 to 30, and 2,691 leafhoppers were removed from this cage. The reproduction in this cage for the total elapsed period of 108 days averaged 430.6 beet leafhoppers per square foot, or 299 per plant.

Population counts were made under natural conditions to obtain information regarding the suitability of halogeton in comparison with Russian thistle as a host of the beet leafhopper. These counts were made on October 5 and 6, 1943, in the areas in northeastern Nevada and northwestern Utah where relatively pure stands of the two plants were found growing in close proximity. Quantitative samples were taken in 10 host-plant patches of each weed. The results show an average population on halogeton of 4.4 $\pm$ 0.9 beet leafhoppers per square foot of host-plant area, as compared with 4.7 $\pm$ 0.9 per square foot on Russian thistle. Statistical analysis of the data showed no significant difference between the population found on the two weed hosts.

In order to determine if the comparative degree of suitability of halogeton and Russian thistle as hosts of the beet leafhopper which prevailed in 1943 continued during the season of 1944, quantitative samples of beet leafhoppers were taken on these two weed hosts on September 1 and 2, 1944. The results of these counts show that the average beet leafhopper population per square foot of host-plant area was 2.95 $\pm$ 0.49 on halogeton, as compared with 8.39 $\pm$ 1.97 on Russian thistle. The analysis of variance shows a significant difference between the beet leafhopper population found on the two weed hosts. The results obtained under natural conditions in 1943 and 1944 give conflicting data which are not explanable at the present time.

Although the beet leafhopper has a long list of known weed host plants, only a very few are important as summer hosts. Russian thistle is the most important of this group owing to its suitability, abundance, and distribution. If halogeton spreads into important breeding areas of the beet leafhopper and becomes as abundant and suitable as Russian thistle, it may become as important a summer host as Russian-thistle.

Preliminary experiments conducted under greenhouse conditions in 1943 showed that halogeton was capable of acting as a reservoir of curly top virus.

Beets and Russian thistle are summer reservoirs of the curly top virus. According to the findings of Severin in California and from evidence obtained in tests conducted in Idaho, smotherweed, or five-hook Bassia (Bassia hyssopifolia (Pall.) Kuntze) is not a host of the curly top virus, although it is an important summer host of the beet leafhopper. With the spread of halogeton into new areas, an additional summer reservoir of the virus will become established.

The introduction and spread of halogeton emphasizes the fact that the beet leafhopper and curly top problem is not static, and that the host-plant complex for both leafhopper and curly top is constantly changing.

Since very little is known regarding the ability of this introduced weed to compete with or replace our native naturalized flora, the determination of its economic importance as an aid in increasing beet leafhopper populations and curly top infection will have to wait for additional developments.

QUESTION: Where did this halogeton originate?

MR. BURGE: We don't know. It is an import, from the high Mediterranean area.

QUESTION: Is it known in any other state?

MR. BURGE: It is in Utah, Idaho and we think in Wyoming.

MR. DOUGLAS: It is in Wyoming in two counties --Big Horn and Paul.

MR. BRACKEN: I am interested in hearing more about this new weed - halogeton. It is a very serious weed to us in Utah and is following our sheep trails into Utah from Nevada. In as much as it contains about 10 to twenty per cent oxalic acid, which is a serious characteristic, something should be done to get rid of this weed, as it isn't widely spread. Russian thistle came in some 25 years ago. Halogeton has come in and is replacing Russian thistle. The sheepmen of our state are very much concerned about it which leads me to request a more detailed discussion on its characteristics and control.

MR. BURGE: Perhaps I should enlarge upon the subject a little bit. We are all concerned for it is serious; more serious than a lot of us want to admit. Last year we established some plots on control with fair results, but the cost seemed high. At the present time, the oils seem to be our best prospect. There is place for a lot of experimental work, and we hope to do some of this work. If we could cooperate with our neighboring states, we would be only too glad to do so. I have suspicioned that it has killed cattle, for cattle have died and in as much as a veterinarian was not availabe and without service of a veterinarian we did not feel free to say that the animal died from halogeton. I do know that one of our big outfits has had a terrific loss in cattle. Perhaps it is something else, but there is a possibility that we have the answer in this weed. We are afraid of it, and I think that the soy bean and tomato people should get some action on this in cooperation with the livestock people.

MR. BALL: Have any feeding tests been made or is it impossible to make them?

MR. BURGE: Feeding tests have been made only on sheep. It killed sheep.

MR. GAINES: You mention the similarity of this plant to Russian thistle. Is the adaptibility very similar to that of Russian thistle?

MR. BURGE: I think so. We have found this plant in the Black Area where nothing else will grow. I have even experienced it growing out by white sage on the flat and on roadsides in a very alkali condition. The moisture content in the growing stage is very high. A plant about three feet wide weighed 7½ pounds due to the high moisture content.

MR. HENDRIX: How does that act in an irrigated section?

MR. BURGE: Where it has access to moisture, the growth is that much heavier.

MR. DOUGLAS: It is not sticky like Russian thistle, it has red stems and blue leaves. The flower is small winged, smaller than that on the Russian thistle.

MR. COX: What is the method of seed distribution. Is it a tumble weed - the same as Russian thistle?

MR. BURGE: Our experience has been that animals get them on their feet and the seed has a very peculiar characteristic, in that when ripe it throws itself off the plant. It sticks very readily to wool and hair.

MR. HAY: Do you have any idea where the original infestation came from?

MR. BURGE: The original plants were collected near Wells in 1935 as part of the Plant Industry program. We didn't know at that time what they were as the botanist could not identify it. How they got there we do not know, but the spread has been very, very rapid.

MR. RASMUSSEN: We made a study of halogeton in Utah and thought that the problem was a little too large for us. It so happened we do not have funds to finance control it. Do you have a similar condition?

SPEAKER: We have areas that possibly measure 70 miles square and I think that is why we should get federal aid on range lands. It is a deal that the counties cannot handle, and a land owner cannot. I think it is going to require federal and state aid to handle it properly.

At this point it was suggested, properly moved, seconded and carried that a special committee be appointed to work on a resolution to get federal aid for range lands. Erickson, Van Meter, and Crafts were appointed.

MR. THOMAS H. VAN METER gave the following report on "Noxious Weed Control on National Forests".

For many years the Forest Service has been combating plants poisonous to livestock and has included this control in the range management program. During the last ten years, an invasion of noxious plants not native to our forest lands has been noted; and in some cases, spreading at an alarming rate. This invasion has been on past depleted areas that have not regained their normal vegetative balance and control measures have been inaugurated on many areas. We believe that proper stocking and range management will generally take care of any infestation over a period of years.

Undesirable or noxious weeds on National Forests fall into slightly different classes than those on cultivated areas. These weeds, for purposes of discussion, are classified as:

1. Plants poisonous to livestock
2. Invasion Plants
3. Plants noxious to adjacent cultivated lands.

The more common poisonous plants found on forest ranges in the western states are:

Larkspur (Species of Delphinium)
Deathcamas (Zygadenus)
Lupines (Species of Lupinus)
Water Hemlock (Cicuta)
Loco (Species of Astragalus-Oxytropis)
Black Laurel (Kalmia)
Sneezeweed (Helenium)

One or more of these plants are native to any of our range lands and present few problems under proper management. Heavy livestock losses are caused by improper seasonal use, excessive grazing, or improper distribution.

Grubbing has been effective as a control measure in areas of concentration, but excessive costs have caused the discontinuance of this method on most forests. The Caribou Forest in Southeastern Idaho has effectively used the Borax treatment on Lupine that had been causing sheep losses along a sheep driveway. In California, control of Black Laurel by the use of chemicals and oil spray is being studied. It is estimated that 2,800 acres of range lands out of a total infestation of 90,000 in Oregon and Washington forests have been treated by various means to eliminate Larkspur and Water Hemlock.

Invasion species that have caused no little concern on forest lands are primarily:

Goatweed (Hyperoum perforatum)
Mules Ears (Wyethis amplexicaulis)
False Hellebore (Veratrum californicum)
Medusa - Head (Elymus caput - medusae)

Goatweed has spread onto many of the forests in the western region. Infestations are reported on the Trinity Forest as well as a number of forests in the Sierra foothills of California. A small infestation on the Umatilla Forest and a 125,000 acre infestation on the Wallowa Forest in Northeastern Oregon is reported. Infestations are known in North Idaho and Western Montana with a predicted spread to the vast range lands of Eastern Montana, if not checked. An infestation on the Payette Forest in Central Idaho indicates a spread toward the range lands of South Idaho. Some treatment by Borax has been carried out in each locality with costs being reported as high as $105.00 per acre actually treated. The high cost of this work and the fact that Borax renders the soil sterile for 3 years, makes this control discouraging, but the rapid spread of the plant makes it necessary that control measures be taken before an increased infestation makes control prohibitive.

Mules Ears and False Hellebore are species native to our mountain meadows that, when the ranges were depleted in past years, established themselves as solid stands on the meadows. Neither are widespread or present any serious threat of further invasion. Once established, however, they appear to withstand competition with desirable forage plants even under full protection. A light oil spray applied during early growth stages will eliminate 80% to 90% of the plants, and full control is affected on the second treatment.

Medusa-head became established in northern California many years ago, but did not appear to present a severe problem until the last few years, when a new infestation appeared in Modoc County. Here it has spread quite rapidly on the better soils occupied by bunchgrasses and Bromus tectorum. Compared with Medusa-head, the latter plant is splendid forage. It does not appear to be grazed at any time, and on maturity, presents a fire hazard perhaps more serious than the annual bromes. If the vigor and ability to spread that it has demonstrated in this area are applicable to all of the good soils occupied by big sagebrush in the western states, this may become one of our most serious pests on range lands.

In many areas our forest boundaries lay immediately adjacent to agricultural areas. Noxious weeds such as Canada thistle and Whitetop have spread from the cultivated lands onto the forest. As weed control programs progress on the agricultural lands, it has become necessary to kill the weeds on forests in order to eliminate the seed source for future infestations. Work of this nature has been carried on in cooperation with permittees and adjacent land owners on many of the western forests.

When combating weeds, we have used sodium and calcium chlorate, borax, oil spray, grubbing, and various other means. All have deficiencies that make them impracticable for the widespread use which is required if the problem is to be successfully met. In Montana alone, it has been reported that over 100,000 acres need treatment on National Forest lands and other states report similar acreages, so any proposed method for large scale use should be reasonable in price, easy to apply and nominal in its damage to soils and other vegetation.

To date the Forest Service has financed their program from the limited range improvement funds allotted as no direct appropriations have been made for this type of work.

In closing, I wish to state that the Forest Service will enthusiastically cooperate with any department or agency concerned with noxious weed control as far as our finances allow.

VOICE: I think we should make every effort to get money from the Federal government to fight weeds.

MR. VAN METER: What are we going to do with the Goat Weed infestation? That weed is taking our range like wildfire. I haven't run on to any control yet.

MR. BALL: It is called Klamath Weed, Goat Weed, and St. Johns Wort. I imagine that we have had as much experience with control of this weed as any other state in the west. And our control practices have been primarily cultivation on areas that were suitable for cultivation, and use of borax, 10 to 12 lbs. to the square yard, on non-cultivated areas. The most recent work that is being carried on in cooperation with the Federal Bureau of Entomology and Plant Quarantine and our state Plant Quarantine people is the biological control through two insects that have proven quite beneficial in Australia. These insects have been brought into California, after thoroughly investigating the possibilities of their detriment to other plants or crops. A complete series of starvation tests have been carried on to prove that they would not be destructive to other plants. They attack nothing but Hypericum. We do not know anything as yet about the natural predetors, which may prey upon these insects. If they are present, our hopes for control will be very limited. We are not hoping to use the insects on those areas, at least at the present time, where we can carry on our regular program with borax and a cultivation program. All this work is under the AAA program in which a large amount of borax has been used. We have a very extensive program on Goats Weed, Klamath Weed, St. Johns Wor, or anything you may wish to call it.

DR. CRAFTS: We are going to have to have research programs and find what to do about this condition. We must cooperate and consider these new problems with research. We are going to have to use biological methods wherever possible and more facilities may be needed.

MR. COX: Isn't it a fact that where they did control with those insects after they destroyed the weed your insects were destroyed and then the same process was repeated over again?

MR. BALL: We have recognized that fact, but if these insects can reduce the infestation on the heavily infested ranges, we feel they are worthwhile. We recognize that there is a seed problem and know that seed will live in the soil for a number of years. Our tests show that this weed will continue to germinate after ten or fifteen years.

MR. HENDRIX: Does it do any good to try and burn Klamath Weed?

MR. BALL: Yes, we have tried burning and we have had successful results, where adequate dry material was present to carry the fire.

DR. ROBBINS: Where these burning experiments were to be carried out, we ran into one difficulty that as soon as you open the ground the seedlings come up like hair on a duck's back. But there are indications that where we can get grass to come back and we get dry material to carry the fire that we can get some thinning. These experiments as set up have not been completed, however, so that we have no data at present.

Thursday, June 7th
Morning Session

Meeting was called to order at 9:45 A.M. by Chairman Burge.

Mr. C. I. Seeley was introduced by Dr. W. W. Robbins.

MR. SEELEY: Gentlemen -- After that introduction, I really don't know what I can say. I feel almost as bad as I did when I read the Statesman this morning. It said I was going to explain the killing of weeds with hormones. As Dr. Robbins has said, something new has been added, as far as weed control is concerned. Most of the work on the hormones has been preliminary, and what their eventual place will be, no one knows for sure. Actually the toxicity of some of these hormones was noted quite some time ago when hormones were used then for controlling apple drop. However, it wasn't until 1941 that Nevada thought you might be able to use it for weed control, and it wasn't until 1944 that any actual work was done, generally speaking, as far as weed killers was concerned. 2, 4-D was picked primarily because it happened to be one that was easily manufactured and was available in large quantities. Most of the work has been done with 2,4-D. As I say, our work started last summer. Applications in most cases have been made with carbowax. Since our work was done with carbowax carriers, in general, our results with certain types of weeds was quite promising, particularly we thought because of cost. At that time, the price of 2-4-D was very reasonable. It since has risen. We made tests on a number of different species, and in general results were somewhat like this. On many of the root perennials we got very good results in that group. Thr results were outstanding on dandelions and some such plants. Some of the bienniels in the second year of growth were outstanding. At the same time, on the root stock perennials, we got a peculiar reaction. We got vertical root kill but not lateral. In most cases we got recovery. We had a recovery by mid-May of around 10 per cent, top kill being around 90 per cent and the plants were quite normal. From the other weeds in that group we got practically no results at all, possibly due to application too late in the season. We tried to put out two, but the weather has been atrocious; lots of rain and wind, all of which has been bad. At the same time the plant growth has not been normal, so the schedule is behind as far as testing is concerned. We have 150 tests out so far this Spring and what they look like at present is no indication at all as to what they will look like three months from now. We have not been able to get the carrier. This factor has been one that has been causing some trouble. Concentration on some of them has been extremely high, but we rather anticipated that because they were so new. We did run into difficulties. One is soil effect that is showing up in many places. In other places, it is causing practically no trouble at all. Another thing that some run up against is that most of the preparations get into trouble in hard water. In some cases it is apparently due to antagonistic salts in the water. In some, calcium precipitates need investigation. Probably the most susceptible has been morning glory and Canada thistle. In the lawn work more or less, we are doing quite a lot of work with 2,4-D as a selective material, and it is better than anything we have had. Some of the grass species have been injured by 2,4-D applications at high concentration as we get some stunting and some burning. Whether or not it is a permanent injury, we do not know. So far as selective work is concerned it may have a place, for we have done a lot of work this Spring on grains. However, the cost at the present time is out of line as far as the cost of material is concerned but this is something we can't say anything about. I had a report from Minnesota and so far this Spring, up until May 31st, they haven't been able to kill annual weeds on account of the temperature. The temperature is low for their work during the period of time when your selective work has past. We have run into much of the same trouble as far as selective work is concerned. The temperatures are frequently too low. I might say this too, one of the things that is bothersome in some sections is

that water is a major factor and it is very difficult to get. We have been working on the principal of reducing water to an absolute minimum; that is, the rate and concentration are inexchangeable. What the limits are we don't know as a number of things have come up relative to temperatures. Every one who has worked with it notices that nothing happens with low temperatures. There are a lot of men who know more about the subject than I do, and I hope that during the period of discussion every one of those men will tell what he knows so that we can actually get all available information together.

MR. ROBBINS: The next topic is Soil Effect of 2,4-D. (Mr. Harvey is introduced)

MR. HARVEY: We have here a concentration series of different amounts of 2,4-D added to different soils and then crops seeded in the treated cans. You see here the result of 30 days' growth of these crops. The concentrations of the chemical in the cans with the oats are 0 (the check), 0.5, .1, .2, .4, .8, 1.6, 3.2, 6.4, 12.8, and 25.6 parts per million of 2,4-D in the air dry soil in the cans. For the peas and sunflower the concentrations are just 1/10 that for the oats. Thus they go from .005 ppm to 2.56 ppm. The fact that we had to use lower concentrations for peas and sunflower than for oats brings out one of the important facts; namely, that crops differ greatly in their susceptibility to the chemical. Oats survive at much higher concentrations than peas or sunflowers and sunflowers tolerate higher concentrations than peas. However, by using a high enough concentration it is possible to prevent growth of any of these plants. This is definite evidence that 2,4-D does sterilize soil to some extent, the amount of sterilization depending on the amount of chemical in the soil.

The three soils also differ in the amount of toxicity shown by the chemical. The Stockton abode clay shows the least toxicity or, putting it another way, it takes more of the chemical to show toxicity in this soil than in the others. The Hanford fine sandy loam shows the highest toxicity and the Yolo abode clay shows an intermediate toxicity.

Oats are markedly affected by as little as 0.4 of a part per million which corresponds to about 1.6 pounds per acre foot of soil. The peas are affected by about 1/10 of this amount or 1/6 of a pound per acre foot of soil and the sunflowers are about the same.

Thus we see that serious effects on crops are possible with very small amounts of the chemical in the soil. Now we don't know yet how long this effect lasts in the soil. Apparently it lasts for 30 days at least and is definitely reduced in 60 days but we are a long way from having final data on it. The difference in the soils indicate that it is tied up in the heavy soils but probably will leach out of the lighter soils more rapidly. This is just a preliminary observation; the data isn't complete or conclusive as yet.

I think the important ideas to get from this are:

1. 2,4-D definitely will sterilize soil for a time.
2. Crops differ greatly in their susceptibility to the chemical.
3. Soils differ in the extent to which they show toxicity of the chemical.

We need much more information on all three points, particularly on the length of time the toxicity persists in the soil and the factors affecting decomposition or breakdown of the chemical. In another year we hope to have some of the answers but right now there are a lot of things we don't know about 2,4-D.

When the meeting is over, I hope you will come up to the front and look over this toxicity series more thoroughly. I have given you only the highlights of it in this discussion.

MR. EVANS: I am interested in knowing how much water you would use with 1.6 pounds per acre.

MR. HARVEY: These concentrations are based on the air dry soil in the cans. Water is then added to bring the soil moisture up to field capacity. The actual amount of water varies with soil type, less for lighter soils, more for heavier soils.

MR. EVANS: What would be the rate of penetration on those lighter soils?

MR. HARVEY: I really don't know. We have done no penetrating work as yet. Our work and results are all preliminary.

DR. CRAFTS: With our past experience with leaching of chemicals in the soil, we have come to recognize two types of behavior. Arsenic will be fixed by most soils. On the other hand if you take nitrate and chlorate it will be distributed throughout the soil. 2,4-d may compare more with borax which fixes loosely. We have tested eight California soils. Hanford fine sandy loam is a highly granitic soil; the nearest thing we have to the soil in this region.

MR. REYNOLDS: Would irrigating right after it was put on wash it down on the surface?

DR. CRAFTS: It is going to depend on soil type.

MR. FREED: Do you think that the soil colloid, as in the case of arsenic, would effect the crops grown on the soil?

MR. SEELEY: Of the ones that I have checked, peas have the greatest tolerance of any vegetable crop.

MR. FREED: What are some of the more susceptible?

MR. SEELEY: Such things as carrots and lettuce are extremely susceptible. Beets went out badly. The thing that rather surprised me was the amount of bean resistance.

MR. EVANS: Has anyone here any observances as to the effect of the 2,4-D on the microflora of the soil?

MR. SEELEY: I can give you some second hand information. This was preliminary work again, but the information I have is that it has pretty bad effects as far as soil bacteria is concerned, but very little effect on fungi.

MR. ROBBINS: The bacterologist at our station applied 2,4-D to his lawn. Following the application, he applied ammonium sulphate and he made the remark that he got no response out of the ammonium sulphate for a very long time, and he was wondering if it had any effect on the bacteria in the soil. I think he will make some study of 2,4-D on the microflora bacteria of the soil. We need to know more about that. Doesn't this work indicate to you people that we had better go a little bit slow on our application of hormones to agricultural soil? A farmer not long ago said to me -- "I have a field prepared to seed to alfalfa and there is a morning glory stand on this field. I would like to treat with this hormone, get a kill of morning glory, and then seed to alfalfa." In the light of your work, what advice would you give him with respect to seeding with alfalfa a few weeks after the application of the hormones?

Answer: Farmers should be advised to proceed cautiously until more is known of the effects of 2,4-D to soils.

MR. ROBBINS: I would like to have Dr. Crafts give a few points from Zimmerman.

DR. CRAFTS: I wrote to Dr. Zimmerman to get an analytical method of testing for this chemical, but in the course of his letter he mentioned that they also had had this sterilization effect on soils. Tomatoes in pots that had previously held soil treated with 2,4-D were affected even though the pots had been washed. Of course we have no idea at all to what concentration 2,4-D was available to those plants. It probably was very low.

I have had a letter from Mitchell. He tells me that they have indicated that this chemical will break down very rapidly in moist soil. In the East where they have summer rainfall, they apply it and come back six weeks later and plant a crop and get by. We couldn't do that in California because at the time when our soils are warm, unless they are irrigated they are dry. There is one point I would like to add though regarding the leaching of this material. We find that if you want to leach the chemical from the soil, dike the area and put two feet of water on that soil, and then keep a constant downward movement.

DR. ROBBINS: Are you sure it would apply to this chemical?

DR. CRAFTS: Only the evidence that has come from the East that at least the grass species seem to be doing well. Our real evidence is very scarce.

DR. ROBBINS: Let's go to the discussion of plot work with this 2,4-D.

MR. HARVEY: I think we could probably best start it by discussing individual species. There are differences in response to 2,4-D treatment of the various perennial weeds in which we are interested. Morning glory is one of the more susceptible species and Hoary Cress is rather resistant. We have quite a number of plots on Hoary Cress and Russian Knapweed but not many as yet on Morning Glory. Russian Knapweed is tough, and part of our trouble with it is that it is difficult to wet. Wetting and penetration are two separate factors. On some of the plots we can get wetting very readily, but that doesn't mean it is going to penetrate.

Morning-glory. This weed is apparently one of the easiest of the perennial weeds to kill. The leaves wet easily and 300 gallons of solution per acre seems ample. Concentrations of 1½ lbs. of the 50% sodium salt or 1 gallon of the liquid preparations per 100 gallons are strong enough for most conditions. One of the companies in California has been making applications of a liquid preparation at a dilution of 1 gallon to 200 gallons of water - a 0.05% solution. So far we can't tell any difference between this and the usual 0.1% strength.

I have seen plots in Southern California on morning-glory that were put out last fall. Rather extensive digging on these plots to a depth of 4 feet showed no survival of vertical roots but there were a few laterals alive. These were small roots and were not making any new growth or sending up new shoots when I saw them in April.

We have preliminary reports of spraying morning-glory in a field of corn using 1 and 2 lbs. of the 60% sodium salt per acre in about 100 gallons of water. Since the spraying was done early in the season some morning-glory came up after the spray was applied. That which was up at the time of spraying was killed and as far as we can tell the corn is unaffected.

There is little doubt that two sprays will be necessary on most morning-glory infestations because not all of it is up at any one time. The evident lack of strong

lateral translocation results in survival of shoots already started but not yet above ground even though they are connected to a sprayed plant. This question of the extent of lateral movement deserves further attention since most of us have seen laterals surviving when the verticals are dead to a much greater depth.

Hoary Cress. This weed is somewhat more difficult to kill than morning-glory and a stronger concentration may be required. However, on some of our plots 0.1% looks about the same as 0.2%. Some of our best results are on early applications when the plants were in the rosette stage or just beginning to bolt, and the weather was cold. Applications made at full bloom or later are reacting very slowly and look poor, although temperatures were much higher at this time. Evidently stage of growth or succulence of the plant is of more importance than temperature. This is further borne out by applications in Northern California at Bieber in Shasta County. Applications made on May 1 were checked on June 1 after a month of cold rainy weather when temperatures were low - probably not reaching 70° all month. The results look about as good as on any plot I have seen.

Hymenophysa pubescens showed a somewhat more rapid top kill than Lepidium draba but we have only a few plots of Hymenophysa and we haven't studied the root effects as yet.

Hoary cress that has been sprayed usually shows a bending of the seed stalk and a change in orientation of the leaves so they stand on edge rather than lying flat. Frequently, the stems swell and split, showing callus tissue. The roots may enlarge greatly, particularly in the cortex, and get watery before they slough away. Many small, crisp, translucent buds appear at the crown and on some of the nearby laterals but I have seen none of these buds put out new stem or root growth. These buds break off easily as though attached insecurely. Some of the plants sprayed at the early bud stage were evidently stimulated to develop parthenocarpy since the ovary developed while the rest of the immature flower remained stunted. Actual death of the plants may take a considerable time. Plots sprayed last fall still showed live roots in the soil this spring but they were making no new growth.

In general, hoary cress is more difficult to eradicate than morning-glory and the chemical acts more slowly. Probably early spring applications will be required for best results but we need more information.

Russian Knapweed. The results on this weed have been extremely variable. It is more difficult to wet than either morning-glory or hoary cress and so far the kill has not been satisfactory. The best plots of Russian Knapweed I have seen were at Bieber in Shasta County again. After one month of cold rainy weather the tops were dead and most of the roots dead and rotted. Near Sacramento we have some plots that look fair and others that are poor. The top growth responds very quickly to treatment by bending and twisting but may remain green for a long time, with some splitting and callus formation. In the greenhouse, plants sometimes grew out of the effects and sent up new growth when treated with more dilute solutions. Much more work is needed on this weed to ascertain the best time to spray and other factors involved.

Lepidium latifolium. Treated plants show the greatest development of callus tissue of any species I have seen. The stems enlarge to several times normal size and appear to be completely filled with callus tissue. In addition, thick pads of callus form at the nodes, often completely encircling the side branches. Reaction on the roots is slow and we don't know yet whether they are completely dead. Probably our best results have been a bushy regrowth following mowing of the older plants. No extra wetting agent seems to be needed.

Canada Thistle. We have very little information on this weed. I saw plots in Southern California soon after spraying and the tops were twisting and going down.

Later observations by Walter Ball showed a good root kill on some of the plots.

Klamath Weed. Early spring treatments when there was only a small amount of leaf surface gave poor results, the plants grew out of the effects and showed no root injury. Later sprays when the plants were 12-18 inches high and with added wetting agent so the leaves were actually wet gave very good results. Wetting and the timing of the treatment seem to be important on this weed but with proper application it can be killed.

Miscellaneous weed species. Gaura sp., which are serious pests in Southern California, were effectively controlled by spraying as was artichoke thistle. In the latter case the roots rotted out quite rapidly, leaving a hole in the soil lined with the bark of the root. Blue lettuce is apparently easy to eradicate if thoroughly wetted with the spray. Fennel, a common roadside perennial that is resistant to oil sprays, was killed where it occurred in some of the plots sprayed for other weeds. It again must be thoroughly wet with the spray. Where only a portion of the plant was hit with the spray the stem curled but the plant survived. Milk thistle killed rather easily when young and succulent.

Woody species. Blackberry, on the few plots we have, appears to be growing out of the effects of the spray. The leaves and young growth twisted and curled and some of the leaves were dropped but apparently healthy new growth came out soon after. Much the same thing happened on the early sprays on poison oak. Young shoots and some of the new growth was killed, the leaves turned yellow to red, and dropped off. However, in a few weeks new growth was coming out. We have made some later applications when there was more leaf surface that look better so far but it is too early to tell. Preliminary observations on willows look good but, again, it is too early to be sure they are killed.

Aquatic Weeds. Cattails and Tules: Results on these weeds are quite promising. Tules are easier to kill than cattails but may require additional wetting agent to thoroughly wet the plant. Cattails require some penetrating agent as well as a wetting agent. Raynor has been successfully using 4 gallons of diesel oil per 100 gallons of spray for this purpose. The common cattail (Typha latifolia) is easier to kill than the narrow-leaved species (Typha angustifolia). It appears to make little difference in the kill whether the plants are actually standing in water or are rooted at the water line or above. Most of the work on cattails and tules in California is being conducted by Mr. Raynor.

Hydrocotyle umbellata L., one of the floating aquatic weeds, was killed by spraying the emersed surface with the chemical. The sprayed plants rotted and dropped to the bottom of the ditch. Since only a small area was sprayed, new plants from the surrounding untreated infestation pushed in as the sprayed plants disappeared. Spraying is much cheaper than drag-lining, which is the method now used to control this weed. If spraying operations were started on the high end of the ditch and canal system and worked down with the flow of the water, it should be possible to eliminate this pest. So far, we have no plots on water hyacinth, a similar plant of much greater economic importance, but we hope to treat some this summer.

Kelp or swamp knotweed (Polygonum coccineum Muhl.) is another aquatic species that has been killed with the hormone spray. On this weed it is important to see that the spray wets the leaf surface. Most of the Polygonums are waxy-leaved and difficult to wet.

Lawn Weeds. Preliminary work on lawn weeds indicates that dandelion and plantain are easy to kill without seriously damaging the grass. A concentration of 0.1% is sufficient and lower strengths may be just as good. A rate of 200 gallons per acre seems to give enough wetting. From the information we have, blue grass is quite

resistant to the hormone spray but some of the other lawn grasses, such as bent grass, are less tolerant.

Less is known about other lawn weeds but Oxalis species are somewhat resistant, with the red variety especially so.

Annual Weeds. Observations in the greenhouse on several weed species show mustards and sow thistle to be quite susceptible to the spray. Chickweed curls up easily when sprayed lightly but many plants have been observed to grow out of the effects and develop more or less normally. Mallow is resistant. Although the leaves become fan-shaped and distorted, many of the plants proceed to grow and flower. Knotweed is resistant and difficult to wet, as is tar weed (Amsinckia sp.).

Conclusions. There is a tremendous amount yet to be learned about this new chemical. In general, it seems that a concentration somewhere around 0.1% is usually sufficient, although a few species may require as high as 0.2%. In most cases, however, we should work from 0.1% downward to the lowest concentration consistent with eradication. As to volume of spray, all we know now is to wet the plants thoroughly. There seems to be no advantage, on perennial weeds at least, of soaking the soil with the spray. There are many instances where much stronger concentrations and lower dosages would be more feasible. For example, airplane application of 300 gallons to the acre is out of the question but if 50 gallons or less of a more concentrated solution, say 0.6% to 1%, would give the same kill it would increase the possibilities of use. This phase deserves more work. However, the noticeable deficiency of lateral translocation leads to the belief that good coverage of the plant with the spray is essential.

One of the most important factors appears to be the growth stage and growing conditions of the plant. Results are slower on older more mature plants and on dry or stunted plants even though temperatures may be higher. We do not yet know what the actual kill on such plants will be but they definitely appear to be more difficult to kill than young, succulent plants.

The soil sterilizing effect needs further study particularly with respect to the length of time the chemical remains in the soil and the factors concerned in the breakdown or disappearance of the chemical. That the chemical does sterilize soil to some extent is without question, and indiscriminate use of it may result in damage to succeeding crops.

MR. RAYNOR: What was your soil temperature on the Morning Glory last fall?

MR. HARVEY: The temperature would go below 70 degrees.

MR. BALL: Clarence mentioned the fact that 2,4-D moves vertically and not laterally. What is the actual reaction within the plant? We are both meaning the same thing by that.

MR. HARVEY: I don't think any one knows what the actual reaction is as yet. Apparently, the entire growth set-up of the plant is thrown out of balance. With enough chemical the plant dies. With less chemical the plant may survive but be markedly changed in appearance. This is particularly true with Russian Knapweed. The leaves turn up on edge and also show formative effects. I might mention that we are getting peculiar effects on grass. We have some annual bluegrass that you would swear is an onion plant. Here are some plants of rye grass from sprayed plots which shows deformation. I will pass it around so you can see it. We are not sure what it is going to do, whether it will finally die or not. We also have evidence of better kill of vertical roots than lateral ones but we don't know what it means other than that it is tied up with translocation of the chemical.

DR. ROBBINS: We have heard this discussion about 2,4-D. What is your conclusion? What do you think about it? Dr. Evans will you lead off the discussion.

DR. EVANS: I have a lot of hope, but we lack a lot of information about it. I saw some articles referring to the work at Geneva and wrote a letter to New York and got a very long reply together with some reprints. I asked for some suggestions. I suppose that they have had considerable experience under very different climatic conditions, and I think the most important note in it all was "Be Cautious". There are a lot of things to be considered and a lot of those have been discussed here. I suggest, Dr. Robbins, since you and I happen to be on the program for next year maybe Klages' request might be answered at that meeting when we come together with a lot more definite information. I can see a lot of danger in this and I think we might get a kickback if we are not careful. I think it has great possibilities, but great danger. I would like to see the incoming officers try in some way to get a summary on the experimental work now being set up by all the states and by the Research Department of the chemical companies to see if we can't get something out to guide us all. We have considerable money to put into this if we had something to guide us.

MR. MORRIS: I got most of my early information from the "Country Gentlemen" and "Better Homes and Gardens". I couldn't believe quite all I read. I came with considerable suspicion about 2,4-D, and I couldn't believe that it was as good as it was represented to be. This discussion has been very instructive to me and I think I have more confidence than I had before I came. I would like to further Mr. Evan's recommendation that we should all go with considerable caution or the first thing we know, we will stick our necks out and someone will take a whack at it. I think it may be a good tool but we need more information and I hope that before the next conference we will be able to report something more definite.

MR. OTIS: I think we should hear from Virgil Freed who is conducting the research work in Oregon. He is doing considerable weed control work.

MR. FREED: I agree with the two gentlemen that with 2,4-D we should go slow for there is a possibility of getting our necks stuck out and having somebody fly an axe. I think 2,4-D opens a new field of research in weed control. I think it has been a good thing to have 2,4-D publicized as it has been, because it has awakened the public to the problems of weed control and certainly with the spectacular results reported in the "Country Gentlemen" and "Better Homes and Gardens", they have taken more interest in weed control work. I think it is a good opportunity for us to further that interest, but with 2,4-D there are so many factors involved before we can make recommendations on it. I think it will be two or three years before we have any concept of this compound. I think it would be well for us to recommend to some reputable medical school that work be initiated with this material to determine its effect as a compound on animals.

MR. STARK: Has anyone had any experience with this on livestock?

MR. RAYNOR: We don't have any experience with large animals, but we have made tests on small animals and the tests indicate that large doses by mouth are not injurious and applications through the skin are not injurious.

MR. HOBSON: Are you having any difficulty in mixing the chemical? If so, what's the remedy?

MR. HARVEY: It depends on what preparation you have. We haven't had any trouble with the dry salts and the newer liquids are easily mixed. Last year Weedone was a tri-chloro acid and was very hard to get into solution, but the materials this year are not so bad. That is why they use carbowax to get the acid into a suspension.

Most of the liquid materials are at least better than they were in going into a solution. Seeley says that with hard water he had had some trouble. Several of the materials give some trouble in mixing but I think this will be solved by the companies. We must remember that this is a new chemical and there hasn't been time to work all the bugs out of it as yet.

MR. BURGE: We should have a few brief remarks from the various state representatives.

MR. KUHNS: I don't think that we have much to report. We made a survey on weed operations for 1944 last fall. I think the secretary has copies of that. Just one litle thing that we are doing -- we have supplied each of our county agents throughout the state with a number of what we call an information sheet. We're asking them to carry on a little experimental work with these various 2,4-D preparations and we are asking them to prepare a short information sheet, showing the location, date of application, type of soil, temperature, and all of the other factors that might be of interest, and give their notes on their observations and final observations in the fall. We will then assemble all that material and hope that we will get a little information. Just how valuable that will be, we don't know, but we think it may be helpful. Starting July 1st, Idaho will employ a full-time man on weed research.

MR. MORRIS: Well, I haven't very much to report due to the fact that our labor shortage has been very keen, and we have had a very difficult time even keeping a skeleton organization on our weed control. However, we are branching out considerably on our selective sprays on peas and the results appear very encouraging. On grain, we have been using Sinox principally, but have a set of experiments outlined now where we will use 2,4-D.

MR. FREED: The thing that might be of interest to you in Oregon, and you have had some experience with that in California: we have tried 2,4-D on Wild Gorse and it won't touch it. In the preliminary work, the oils seem to be one means of controlling the plant, and I imagine it will take several applications to kill it. The plant was introduced in Western Oregon around 1900 from Scotland and Ireland. It now covers 20,000 acres and it is spreading up the coast and has been found in Washington. We are attempting to find some means of control of the plant. I don't think that we can ever eradicate the plant economically, but I believe without question that it is one of the toughest plants ever encountered in Oregon or any place.

MR. OTIS: We can never hope to get very far in weed control work without our planned and financial research program. Weed control has been a sort of stepchild and in many instances when it comes to research work, we are just kind of skimming the surface. So far most of this meeting has been concerned with the chemical means of controlling weeds. That is one small phase of the whole weed problem. Most of the farming operations that are performed are performed largely to control weeds. We plow, we disc, we harrow. These are all cultural methods of weed control and must be given more consideration in our research work. Cultural methods are going to be one of the farmer's main standbys in this work. So much for that.

I would like to give a word of praise for the commercial men. They like the weed research are often stepchildren. We let them in and put them in a corner. But we in Oregon have rather nice relationships with commercial men. These commercial men play an important part. They are necessary and we appreciate the relationships that we have had with them, and so far as Oregon is concerned we want those relationships continued. I have told many of the commercial men themselves individually, and I want to publicly announce it.

The last thing is, we have found in our extension work and educational work in Oregon that close cooperation with the AAA program has been of great assistance to us when it comes to getting weed control. As soon as we had a weed control practice written

into the AAA, we made a great step forward and we found many more weeds eradicated. We strengthened the weed control practice by laying down step by step what the farmer must do. Before he can receive payment from the AAA, he must sign a contract with the AAA. In the event AAA has been paying many thousands of dollars in the past for weed control that has not been used for weed control, we hope this new practice will eliminate this waste of money and at the same time will result in more and better control. We completed a series of educational meetings at which time we talked to 125 or 150 fellows who had signed the contract with the AAA, and were going out and by cultural methods were going to try to work out the eradication of Morning Glory. We think we will get more weeds eradicated by those 150 men by the result of this practice than we would with 500 or 1000 who hadn't signed the contract.

MR. HOBSON: I would like to turn part of this time over to Dr. Evans. I would like to say in general, however, that the cultural weed program in our state is going forward as rapidly and with as much interest as it has done in the past. There is a continuous demand and a growing demand for cultural work and also with reference to chemicals. Our people are desperate for chemicals. They are using all they can get hold of and I think the general interest is increasing constantly. We have many calls and our personnel is not sufficient to supply all of these demands. We are attempting to do what we can under the circumstances as well as we can. I think generally we are going to have all the money we can use. The money matter is not a serious thing in our state, but our problem is the lack of equipment and labor.

MR. GAINES: One of the important developments in the State of Washington in this last year was the effectiveness of the work of the California Chamber of Commerce which resulted in the loss of our weed specialist. I may say the general sentiment toward weed control is increasing quite rapidly and I'm hoping that we can really do something in the next two or three years to get statewide weed control work in Washington.

MR. THORNTON: I think the two greatest things we have had from this meeting is first the danger of applying 2,4-D, which is much greater than I anticipated, and the possible uses that may be made of it, which is also greater than I anticipated. I would like to emphasize that the information be obtained from the other states. In Colorado, we have done a thing very similar to Idaho. We have furnished each county with a uniform test involving four treatments and four dates of application. We don't know how much good we will get out of that. It may do some good. Our cultural work is going on more rapidly than before. We are entering in on this 2,4-D program, just getting started, so information is badly needed. This meeting will be of great value.

MR. HARSTON: I believe the outstanding development in Wyoming is the fact that our experimental station has taken a step toward doing experimental work towards weed control. The research man is not here, but he plans to carry on some work with 2,4-D. I think Mr. George Boyd, of the extension service, has done more work in the extension field than any other in the state, and even though he admits the educational part of the program needs a great deal of stimulation in the future, I find that the farmers in Wyoming are very weed conscious. In fact, they are going out and buying this material and are putting it on their land. We are stepping cautiously as a department. We will carry on with the weed cultivation program, and the methods we have tested in the past, and I hope that we can benefit with the information.

MR. THORNTON: We are contemplating taking some fundamental work with using electricity with weeds. If you have any ideas, we would appreciate your help.

MR. BRADLEY: I will just say a few words. We in the AAA have found where we can get good cooperation with your weed control organizations, we can get the job done.

Where we don't, a lot of money has been spent for nothing. I can say frankly that AAA is not interested in spending money for nothing in weed control. With the amount of money allocated it has been the general policy to keep weed control a practice of first priority. I hope you folks know that with our limited allocation of funds, we don't do all the work that is desirable.

As a result, we have to distribute our money on the basis of conservation needs. We have tried forming a divisional angle to keep weed control as one of the practices of first priority. In most cases I think that is being done. I would like to report just one thing and that is in respect to the cooperation we have had with the states. I think it has been worthwhile, and I would like to say to further Chet's statement that wherever we find that our money is not being spent to advantage, we are going to tighten up our practice. I would like to have recommendations from you folks, if you have anything to say, because we are starting now to prepare our handbooks for 1946. I would also like to mention, this weed control is too big for any one outfit or any one agency. I think perhaps if we all work together on it, we can get something done. It is pretty hard to sit down and write a report on weed control when we have been working on it for 8 years and still there are considerably more weeds than when we started in. Perhaps it has helped in some places.

MR. HOBSON: I have noticed the trend of conversation this morning has been largely to experimental work, but to the state of Utah the activities of the AAA have been very helpful. I think every encouragement should be given to AAA to continue this practice. In our state, we have offered the service of our supervisor to pass on the program of cultivation or use of chemical as being good or bad. It has gotten us into some difficulty in some cases. As a whole, it has proved quite beneficial. A supervisor may not give his opinion as to whether a farmer is eligible for payment, but at least I think we should go far enough to pass that information on to the county committees. If AAA payments go out of the picture it is going to be mighty difficult to agriculture. Prices are so high. I would like to see everybody encourage that where it is possible to do so.

Meeting was adjourned for lunch.

Thursday, June 7th
Afternoon Session

Meeting was called to order at 1:45 by Chairman Burge.

MR. KUHNS: Tomorrow we are having an all day session at the hotel regarding seed law enforcement and modification. The meeting will be held in one of the rooms off the mezzanine. I think that most of the states that are represented at this meeting will also be represented there and we would like to invite any or all of you to stay over and meet with us tomorrow. One thing that we will give particular attention to is the unifying of our state noxious weed list in relationship to our seed law. As most of you know, every State has a little different list and it makes for confusion in our inter-state movement of seed. Last year we made a little start on working on a uniform list and Mr. Davidson, Chief of the Seed Law Enforcement Section has made some suggestions. Tomorrow we are going to try to come to a more definite conclusion. I am mentioning that now with the thought that if you can't attend the meeting tomorrow, you contact your state representative and talk that matter over with him. Relative to the tour this afternoon as soon as this meeting adjourns we will ask all of those who have agreed to supply cars to get the cars in to place along the 11th St. entrance. I think probably you can double park there. We would like to have all of you come whether you are interested or not, so we can show you some of the worst parts of Ada County. I think we will have plenty of transportation for everyone. The trip won't be long and you won't have to wade through swamps or fields. We will make perhaps a half dozen stops, but most of it can be seen from the cars. We will have a public address system on one of the cars so that Mr. Cox and I can try to tell you what we have.

Chairman Burge called for the reports of Committee - Committee on Program and Place of Meeting.

MR. EVANS: Mr. Chairman, with apologies I will state we were unable to convene our committee until a few minutes ago and with your forgiveness, we would like to recommend that the meeting be held somewhere in the neighborhood of Reno or Davis next year, but that the exact location be determined later on when we will know more what is going to happen over in the Pacific and what hotel accomodations are going to be. With your approval, we would like to leave it like that. Secondly, we would like more time on the program. I think the program should not be outlined. The Committee, through correspondence, will make some recommendations with whatever officers you elect here for next year. One thing we would like not to make a definite recommendation on, but to get your reaction about, is whether or not we want to change the time of these meetings to earlier in the year, probably late in the winter, so that we can have the results of the next year's work to aid all the States in planning their research program for the following year. Now that's quite a change and we don't make a recommendation, we would just like to get your reaction on this.

MR. BALL: The reasons for having the meeting in June this year and in the past is because this organization started in conjunction with the Plant Quarantine Board in the eleven Western States. Their meetings are definitely set for the last of May and the first of June and they have always been held during those months. However, we have gradually lost our cooperating members. For several years the quarantine representative was also the state weed representative and it was necessary to hold the meetings at the same time. Earl Hutchings and George Schweis are the only two of those men left. Hobson will take over down there and Lee is taking more of an active part in behalf of George Schweis. I see no reason why there should be any

question as to whether or not we should move this to another time. Harry Spence and I have thought for years that it would be a good idea to have it sometime in the fall, winter, or early spring.

MR. BURGE: I think some discussion on that would be in order. What do you fellows think?

MR. FREED: I think it is an excellent idea to hold it sometime in the late fall or winter or early spring. In our case this meeting in June is delaying us a week on our work and is breaking into the busy part of the weed control program. Meeting in the winter would not only make information available that can be used in the summer work, but would also be a good deal more convenient for the weed control men.

MR. THORNTON (COLORADO): Along in March would be fine if it could be worked out.

MR. ERICKSON: In holding a joint seed and weed meeting, the objections of an early winter meeting would be that the heavy seed work is on then.

MR. MORRIS: I don't think it would make very much difference. You do have to consider that some of the people are doing some work, but I think there is a real advantage of having it early in the winter; six weeks or two months earlier than this time.

MR. EVANS: I move that we hold a mid-winter meeting. Motion seconded by Dr. Klages. Carried.

MR. BURGE: May we have the report of the resolutions committee? You will remember that we had a resolution committee and a sub-committee and they got together separately and came out with practically the same answer, and so we must be right. Therefore I submit the following resolutions--

1. RESOLVED That the Western Weed Control Conference hereby extends its thanks and appreciation to the Idaho Noxious Weed Association for its hospitality in making the necessary arrangements for this meeting and for the dinner which was enjoyed by all members of the conference.

2. RESOLVED That we extend our thanks and appreciation to Governor Charles C. Gossett for his address of welcome and for his interest in the promotion of Federal and State assistance in weed control work.

3. RESOLVED That cooperation be continued with the North Central Weed Control Conference and that the Secretary be authorized to attend the annual meeting of this Association in 1945.

4. RESOLUTION: Federal Research for Weed Control

WHEREAS, the weed control problem of the United States is of major importance in the production of crops, and

WHEREAS, these problems are of national as well as state interest, and

WHEREAS, weeds as an agricultural pest have been recognized as causing greater losses to agriculture than any other pest, and

WHEREAS, the United States Department of Agriculture has an important place in the field for the control of insects and diseases, both plant and animal;

NOW, THEREFORE, BE IT RESOLVED that the Western Weed Control Conference, assembled at Boise, Idaho, June 6 and 7, 1945, go on record as recommending that the United States Congress create a Division of Weed Research at the earliest possible moment; and

BE IT RESOLVED FURTHER that this Division of Weed Research be established within the Bureau of Plant Industry, Soils, and Agricultural Engineering to conduct basic weed research in cooperation with the existing Agricultural Experiment Stations throughout the United States.

5. RESOLUTION: Funds for Federal Weed Control

WHEREAS, weeds are of national importance and are disseminated by natural as well as artificial means, and

WHEREAS, boundaries are not barriers and weeds become established wherever conditions are favorable for their existence, and

WHEREAS, millions of dollars are being spent annually for the control of weeds for the production of agriculture, and

WHEREAS, many of the areas on which large sums are expended are reinfested from areas where control measures are not practiced sufficiently to prohibit seeding and spread:

NOW, THEREFORE, BE IT RESOLVED that the Western Weed Control Conference, assembled at Boise, Idaho, June 6 and 7, 1945, request the Federal Government to provide funds for an effective weed control program on all Federal land, including especially forest reserves, Indian reservations, Taylor grazing land and national parks.

6. RESOLUTION: A.A.A. Participation in Weed Control

WHEREAS, weed control problems in the Western States are of major importance in the production of crops; and

WHEREAS, the weed problems differ in different areas due to conditions favorable to certain weeds to compete with crops;

NOW, THEREFORE, BE IT RESOLVED that the Western Weed Control Conference, assembled at Boise, Idaho, June 6 and 7, 1945, urge that the A.A.A. State Committees be given the authority to designate the list of noxious weeds in their respective states to which practice payments shall apply, the State Committees to be governed by state legislation which has established, through legislative action, certain weeds as noxious,

BE IT FURTHER RESOLVED that this Conference hereby express its appreciation for the valuable contribution that the A.A.A. weed program has made in the control of weeds in the Western United States.

MR. KUHNS: I hereby move the adoption of these resolutions. It was moved, seconded and carried that these resolutions be accepted by the Weed Control Conference.

MR. EVANS: Moved that we forward copies of these resolutions to all the Commissioners of the eleven western states and a copy to the North Central States Weed Control Convention. Carried.

MR. ERICKSON: Moved that a copy of the resolutions be sent to the state secretaries of the Triple A. Carried.

MR. BURGE: Now may we have the report of the Nomination Committee.

MR. HERSLEY: We, your committee on nominations, beg leave to report as follows: We submit for your consideration the following recommendations. We recommend for President B. E. Kuhns of Boise, for Vice President Bruce Thornton, Fort Collins, Colorado, for Secretary-Treasurer Walter S. Ball of Sacramento, California.
It was moved, seconded and carried, that the report be adopted as read.

MR. KUHNS: I certainly thank you for this honor, and hope that we can make our next season a successful one.

MR. BALL: I very sincerely want to express my appreciation of what Mr. Kuhns has done to make this meeting what it has been. It has, I think, been the most successful meeting that we have ever had --the largest number we have ever had at one of our meetings. Again, I want to express my appreciation and thanks to all the state officials and all of you men who readily accepted the invitation to be on the program and to make this as successful as it has been.

WALTER S. BALL
SECRETARY-TREASURER