hibit could be used to induce farmers to breed this fish in their stock ponds.

(7) Many stock ponds in impervious soils go dry in the summertime. A health officer can often, by proper suggestion, get the farmer to deepen the pond at one point sufficiently to retain some water throughout the period of drouth. This will keep the fish alive, provide water for stock and help to prevent malaria transmission. It can be done in the season of the year when other work is not pressing. A drag scraper and one or two mules could do this work in a short time and give permanent beneficial results.

(8) The *Gambusia affinis* is present and waiting to help the health officer, waiting to work 12 to 24 hours a day for him throughout the entire mosquito season without pay. The important question is, Are the health officers ready, or are they only waiting? Will they give the *gambusia* the little assistance necessary to overcome the barriers placed by Nature in front of this small fish of big sanitary importance?

Discussion follows paper of Mr. Johnson, page 376.

EFFICIENT AND ECONOMICAL USE OF OIL IN THE PREVENTION OF MALARIA*

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Ever since the inception of malaria control work, oiling has occupied a prominent place in such work, and probably, in the minds of the public and of many physicians and other people interested in health work, it is regarded as the most important factor in malaria control. The fact that oil regularly applied to standing water will prevent the anopheles mosquito, the sole means of the conveyance of malaria from person to person, from reproducing, has made a profound impression upon the public mind far out of proportion to its real importance.

*Read in Section on Public Health, Southern Medical Association, Fifteenth Annual Meeting, Hot Springs, Ark., Nov. 14-17, 1921.

To accept oiling as the panacea of all mosquito ills, a thing which the general public and all too many health workers have done, is to overlook far more important methods, and methods which should by all means have precedence over oiling. No amount of oiling can ever take the place of adequate drainage and filling. The most fundamental principle of malaria control work should be drainage and filling of all anopheles breeding places wherever economically feasible.

We have come to believe that in general permanent ponds, pools, cisterns, wells and the like in which anopheles may breed can be controlled much better by other means than by oiling. Oiling is dependent upon human nature, which is far from infallible. In the common top-minnow, or *gambusia*, we have a destructor of mosquito larvae and pupae which does not depend upon human nature, which works three hundred and sixty-five days a year, and which never takes a vacation or goes on a strike. Why depend upon oiling when we have this far better means of control which can be used in such places as those mentioned? Use *gambusia* instead, for they have given the desired results more economically and more effectively in almost all places where tried out.

In other places we have found that oiling does not work at all. In polluted water, oftentimes in that which is so slightly polluted that anopheles will not breed in it (and it should be understood that anopheles will not breed in heavily polluted water), oil sometimes will not film. When we consider that the action of the oil is to form a film over the surface of the water, through which the anopheles larvae and pupae cannot breathe, it is easy to see that using oil on polluted water where it will not film is a fine way to waste oil, but a very inefficient and uneconomical way to use it. Such places can be controlled by applying "Kreso Dip No. 1" with a hand mist-spray pump.

When the necessity for using oil in such places has been eliminated, a long step has been taken in the efficient and economical use of oil, but there is still left a wide field in which, so far as our present knowledge goes, oiling is supreme. In wa-

ter barrels where anopheles sometimes breed, in semi-permanent ponds (those which may last long enough after a rain to produce anopheles, but not long enough to justify the use of gambusia), in the innumerable pools, puddles and marshes which accompany a rainy spell during the breeding season, in ditches where the current is not swift enough to prevent anopheles breeding, we know of nothing which will take the place of oiling. In anopheles control work it will be found that this class of work which must at present be taken care of by oiling will cause by far the greater proportion of the continuous expense, will give by far the most trouble, and will give the public by far the best opportunity to offer the objection that the work is being inefficiently and uneconomically done. It is, therefore, of the greatest importance to do this class of work with the utmost efficiency and economy possible.

For the first, or water barrel class, a mixture of half crude oil and half kerosene should be used. Waste oil from garages—that drained from the crank cases of automobiles—can also be used, but in this particular class it will be more effective if strained and mixed with an equal volume of kerosene. The use of the "mosquito oils" now being so highly recommended by several companies should be avoided, if possible, as many of these have proved to be very unreliable and ineffective. The use of black oil in the place of crude oil should also be avoided, as black oil is very inferior and will almost always fail to do the work expected of it. It is best to put a thick coating of oil directly on the surface of the water in the barrel, some advocating the use of as much as a pint to a barrel: such an amount of oil holds a film sufficient to prevent anopheles production for several weeks, whereas a thin film requires renewal once a week and almost invariably some barrels are missed in the renewing and become breeding places.

In all other places a mixture of equal parts of crude oil and kerosene will give the best results. The proportion should not be changed unless experimental trial shows that in the particular locality in question and at the particular

time in question another proportion works better. Even in cases where this is true, it should be borne in mind that at another season of the year the fifty-fifty mixture may become more efficient. Waste oil from garages, mentioned above, may be substituted for this mixture with success. Oil used on this class of work should be applied once a week and as near as possible on the same day of each week, thus making sure that there is an unbroken film of oil on the water at least once every seven days. If this is not done, a sufficient time may elapse between films to allow the production of a crop of anopheles.

The application of oil in all this work is best accomplished by thoroughly mixing the oil with sawdust and applying it in the manner described below. Sawdust used for this purpose must not be green, must not be hardwood sawdust, and must be dry. Enough sawdust should be used so that the mixture is not wet to the touch, is of a brownish or leaden hue rather than black, and so that the particles will separate cleanly when a handful is thrown on the water: if the particles clump together on such a test, more sawdust is needed. The amount of sawdust used will be surprising: several times as much sawdust as oil will be necessary.

This sawdust and oil mixture should be allowed to stand for twenty-four hours to allow the oil to soak well into the pores of the sawdust, and is then ready for use. In oiling ponds, pools, and puddles, the sawdust should be scattered or sowed on the surface, as one would sow wheat or oats. Particular attention should be paid to the edges and to vegetation in the pond, as these places are where the anopheles larvae and pupae are most liable to be. Enough sawdust should be used so that there is an unbroken film of oil upon the surface, especially in the places noted.

Ditches, with the exception of seepage ditches, where the flow is small and slow, should be oiled by sowing several handfuls of the sawdust on the water at the head of the ditch and then repeating where the film thus formed becomes inadequate: this distance must be determined by trial and will vary greatly in different ditches and under different con-

ditions of flow and of cleanliness of flow line. It may in some instances be as great as a quarter of a mile or even more, and under other conditions not over a few hundred feet.

Seepage ditches should be oiled by soaking a ball of common waste about the size of a baseball in the same mixture of oils for the same time, and then pinning it to the bottom at the head of the ditch with a peg or twig so that the whole is entirely below the surface of the water. One hundred feet below this a boom should be placed entirely across the ditch with edges two inches below and two inches above the flow line. Just below this boom another ball of waste should be secured in the same way as the first, and this procedure repeated throughout the length of the ditch.

In oiling semi-permanent ponds, a three-quart flour or sugar sack may be filled with oil-soaked waste and sawdust, allowed to soak in the same mixture of oils for twenty-four hours, and then moored in the pond by a rock and rope long enough to allow the bag always to float, but not long enough to allow the bag even to touch the sides of the pond. Such a sack will give off at once a film sufficient to kill all anopheles larvae and pupae present and will then maintain for a long time a film sufficient to prevent anopheles from laying their eggs on the water. In two ponds oiled by this method in Montgomery, Ala., anopheles breeding had not been resumed eleven weeks after the sack was moored. The big advantage of this method lies in the fact that less oil is used, the labor cost is reduced, and the human equation is eliminated for a considerable length of time.

In oiling places it is difficult to reach with sawdust, as under low buildings, the same mixture of oils, or waste oil from garages strained and mixed with an equal volume of kerosene, may be applied with a knapsack spray can. For general use, however, the knapsack spray can is heavy, unwieldy, wastes oil badly, and is all too often used in a ridiculous manner by laborers; and the use of it should be reduced to the smallest amount possible.

An adequate inspection service is an absolute essential in efficient and econom-

ical oiling. Oiling is very unsatisfactory at best. Certain experiments now under way give promise of revealing a method of control which can be used in the place of oiling and which will be far better than oiling. However, until the experiments have been concluded and the method proved good in actual practice, it cannot be accepted as a universal substitute for oiling. In the meantime we must trust to oiling, and if the oiling is to do what is expected of it, an adequate inspection service must be maintained.

The first step in good oiling is to confine the oiling needed to the smallest amount possible by the use of drainage, filling, fish and the use of other larvicides in places where oil will not do the work. What oiling is then necessary should be done in accordance with the methods outlined above; and an adequate and efficient inspection service should be maintained to make sure that the oiling is really doing the work which is required of it. The oiling will then be about as efficient and economical as we know at present how to make it.

DISCUSSION

Papers of Mr. J. A. LePrince and Mr. E. B. Johnson.

Mr. Samuel F. Hildebrand, U. S. Bureau of Fisheries, Washington, D. C.—Mention has been made of the research still required and of our limited knowledge of the use of fish; and that, of course, is very true. However, I feel that we are making wonderful progress. A year ago last spring I was assigned the pleasant task of visiting the various health officers in the South. I went from state to state, first calling upon the state health officers, and thereafter I went wherever they directed me to go. At that time there were very few health officers who were using fish. They all had heard of fish and their application in anti-malaria work, but they had not reached the point where they really felt that it was a practical thing. Only six months later, when we had a conference at Louisville, Ky., and even before that, we were receiving encouraging reports. This year the work has spread until I am beginning to fear that the pendulum has swung too far and that there is danger of leaving too much work for the fish to do.

I carried on some investigations this summer for the purpose of acquiring more information relative to the true value of fish as agents for the control of mosquito production. The details of this work have been given before another section of this meeting. From these studies it appears that even under very unfavorable conditions we can expect approximately 90 per cent decrease in mosquito production by the use of

gambusia, and when there are no barriers in the way we often get complete control. The thing we must work on most is to recognize the obstacles or barriers to which Mr. LePrince has referred, and then we must learn how to eliminate them.

Mr. LePrince is of the opinion, and I have seen this in print and heard it stated by others, that gambusia is more efficient in destroying the anopheline than the culeicine larvae and pupae. The data which I have collected, if they show anything, show that the reverse is true.

Mr. LePrince also referred to the necessity of the removal of vegetation, which is a very important matter. He stated that it must be known to have been removed, not only reported to have been removed. What he meant to say was that such work, if undertaken, must be thoroughly done. I have given before another section of this meeting the result of my experiments in removing vegetation from ponds.

I shall not repeat the details here, but I may say that I found that by partly removing certain types of vegetation and not doing it thoroughly we increased mosquito production about ten times. That is to say, if we had not removed the vegetation in part we would have had very much better control. The reason for this is that the vegetation, if it is dense, very frequently will grow up above the surface of the water, leaving only the slender stems to penetrate the surface of the water, and which furnish little or no protection, whereas vegetation which is scant or which is just growing up has many leaves at the surface and the leaves, when partly or slightly submerged, form the barrier. If, then, the removal of vegetation is undertaken, it must be thoroughly and completely removed.

The suggestions for educational work constitute the most important part of the paper which we have just heard. I wish to give you a few examples of the questions that have been asked me at various times which show the need for education. I am very frequently asked, in speaking of minnows in relation to mosquito control, "How do they catch the mosquitoes; do they jump out of the water for them?" I explain that the fish do not do that, but that they eat the larvae or the wiggle tails of the mosquito which live in the water. That is more news! People have known the mosquito and the wiggle tail all of their lives, but they have not connected the two. These questions do not come from the uneducated alone. They have been asked by business men and by professional people. A lawyer who is a graduate of one of our prominent universities, who has had several years' experience as a lawyer, and has had malaria himself—and you know that a lawyer is supposed to be versed on all subjects—admitted that he had never associated the wiggle tail with the mosquito. A doctor of twenty years' experience as a physician was arguing with me the other day and became greatly disgusted because I insisted that the tadpole and the wiggle tail were not one and the same thing.

Then we have those people who insist and maintain that mosquitoes breed in weeds. I say, "No, they cannot breed in weeds unless there is

standing water beneath them." They say, "Yes," for have they not seen the mosquitoes come from the weeds and trees? Just the other day, a bank president made this same statement, and again I stated that it was impossible, for the mosquito must have water to reproduce its kind. The gentleman turned his back on me in utter disgust.

Only recently a Colonel in the Medical Corps of the United States Army asked me from what the wiggle tail originated. I told him that it originated from the egg laid by the mosquito. He said of course he knew that it originated from an egg somewhere, but he did not know whether or not there were any intermediate stages.

Last spring I was in the office of one of our state health officers when a news reporter came in and asked the health officer for news. The doctor dictated the following statement: "Mr. Hildebrand, of the United States Bureau of Fisheries, is here consulting with the State Health Officer and the sanitary engineers as to the best method of controlling malaria by the use of fish." That statement was quoted verbatim, but here is the headline which was supplied by the paper, "Eat More Fish. Best Way to Control Malaria."

I have given the few foregoing examples merely to show the need for education, hoping thereby to emphasize the timely suggestions offered by the Senior Sanitary Engineer.

Dr. T. H. D. Griffiths, U. S. Public Health Service, Norfolk, Va.—I have been conservative in the use of fish in malaria control. I have had occasion to know that they have done wonderful work in certain parts of the country and under certain conditions anywhere from Texas to the northern boundary of Virginia. But when I can come now and hear Mr. Hildebrand say that the pendulum has probably swung too far the other way, and listen to Mr. LePrince stress so strongly the importance of removing "barriers" against the action of top-minnows, I feel like limiting very much my discussion of the paper.

Now, relative to newspaper articles in advertising these little minnows, I saw a squib recently—an editorial squib—in which it was said that fish were to be raised in this country and sent to Spain for the purpose of controlling mosquitoes. The editor said: "That reminds me of purchasing a 'hair tonic' from a bald-headed barber."

To my mind the most important use to which we can put top-feeding minnows is their introduction into newly made ponds. There is no subject that has struck at the heart of the welfare of the South so much as the impounding of water for hydro-electric power purposes, both from the industrial development standpoint and the health standpoint. Wherever water is impounded in Southern states, arrangements should be made before the water is impounded for stocking that pond immediately or just before the dam is closed. There should be a sufficient number of hatcheries of sufficient size to have plenty of top-feeding minnows to be placed in these waters from the start just as soon as possible.

It so happens that in these impounded water projects—some of them at least—gambusia may

perhaps not have been prevalent there before. Their introduction should be looked after in the large reservoirs and in the smaller ponds throughout the country.

Another point is that in certain sections of the country this year there has been an unprecedented drouth. In North Carolina and Virginia, especially, it has been very dry. Swamps that have been wet for twenty-five years have dried up, and it seems to me there is a possibility of increase of malaria in a normal season or wet season following such a dry season, if the top-feeding minnow and other natural enemies of the mosquito are killed out in those swamps. I think following a dry season we should especially look after the re-establishment of the top-feeding minnows in these swamps and ponds. That would apply especially in connection with rural malaria control.

One other point is the longevity of top-feeding minnows in artificial containers or artificial places where they have been transported from their natural habitat. In June, 1917, I placed ten male and ten female gambusia in an old brick-walled tank about twenty feet wide. The water was very foul and the place was filled up with bricks and chunks of wood, old tin cans and general rubbish. The water was so foul that I had no idea they would live in there a month. A month ago I found about five hundred there. That makes four years and five months. So I find it is safe to conclude that they will live under rather adverse conditions for a rather long period.

Mr. W. H. W. Komp, U. S. Public Health Service, Camilla, Ga.—Influenced by the ecclesiastical atmosphere, this has become an experience meeting, and I want to give testimony as to my conversion to a faith in oil. A new method of anopheles control has been evolved, which makes the use of oil for this purpose a back number. I had the pleasure this fall of being associated with Dr. M. A. Barber, of the U. S. Public Health Service, who is in the audience, and can tell you more about the new method than I can. I have had practical experience in the use of oil as an anti-malaria measure, and I want to make it clear right now that there is a difference between the use of oil as an anti-malaria measure and as a mosquito prevention measure. The two are entirely separate things. The new method is not applicable to culex control, which is its chief disadvantage.

The method Dr. Barber has evolved is the use of Paris green or other arsenical for the destruction of anopheles larvae. Mr. Johnson has gone on record as saying that oil in no case will destroy 100 per cent. So far as we know, Paris green will not give 100 per cent control, but it did give 99.36 per cent control inside of twenty-four hours. It is effective wherever oil can be used. It is also very effective in places where oil cannot be used against anopheles larvae, especially in dense aquatic vegetation where fish can not penetrate and in stream breeding. Oil-soaked sawdust which has lost its oil forms itself a protection for the anopheles larvae, and therefore cannot be recommended. The arsenical dust method will be published in the *U. S. Public Health Reports* and will contain full report

of the method. The arsenical dust acts as a stomach poison, exerting a selective action upon anopheles larvae because of their surface-feeding habit.

In regard to the difference in cost of the two methods I can give you some data. Ten cubic centimeters of Paris green are mixed with two quarts of ordinary road dust. That mixture is sufficient to treat one thousand square feet of water surface. The method of application is simply to sow that dust containing the Paris green over the surface, standing to the windward side so the dust will go all over the surface of the water in the same way that a dust cloud settles on the landscape after an automobile passes on a dusty road.

As to the cost of oil, the usual method is the use of the spray can, using something like one ounce to every fifteen square feet of water surface. Oil costs between 10, 15 and 20 cents a gallon. You can figure the mathematics yourself. On the other hand, Paris green used in this proportion over a thousand square feet costs exactly seven-tenths of a cent at ordinary prices.

Regarding the use of oil in artificial containers, Dr. Barrow, Chief Surgeon of the Central of Georgia Railroad, has reported the use of ordinary lime as a most efficient substitute in rain barrels. He says that one-half pound of ordinary lime placed in a rain barrel will be effective all season. That has not been tried so far as I know except on the Central of Georgia Railroad; but Dr. Barrow has given that particular method prominence, and I am sure it would be worth a trial.

Dr. H. R. Carter, U. S. Public Health Service, Washington, D. C.—Mr. Hildebrand spoke of leaving too much for the fish to do. What he means is that where the fish cannot get at the larvae you can not expect them to eat them. Where there are many fish, if they are hungry, they will go through an amount of growth and trash more than you would think. We must eliminate the protection of the larvae from the fish. As possibly some of you know, Mr. LePrince, Mr. Griffiths and I have worked together—the speaker since 1913, the others since 1914 or 1915—on the problem of the impounded water in the South and how it affects the incidence of malaria. We found its effect was usually very bad. The edges of the ordinary pond, and those you have heard spoken of in Georgia recently, you clean up with spades and shovels. Lake Bankhead, on the Black Warrior River in Alabama, has 235 miles of shore line. I do not think that one man would willingly undertake to clear that with a spade and shovel. The Coosa pond of Lock No. 12, in Alabama, has from seventy-five to a hundred miles. But even that it is impossible to do by hand.

In all these large collections of water the drift, which is heavy stuff, does not protect against the gambusia; but the floatage, which is very small stuff, about one-fourth the size of the head of a pin, is what protects the anopheles from the gambusia. In some places it will be so thick that it has lifted itself out of the water; and, of course, in dry places no larvae grow. In other places it is still soaking wet and the larvae

are on top of it in the film of water on the surface.

Fish are worth practically nothing in floatage. That is to say, they may destroy a million or so of larvae, but that is only a small proportion of the number that are there. In the Coosa pond in 1915 the company responsible for it was very much alarmed at the number of suits brought and wanted to do the best they could to prevent the criticism and the appearance of malaria. All who blamed them for the malaria adjacent to the pond said it was because of their lowering the pond and leaving the edge exposed to the sun. They, therefore, at considerable expense, put in a telephone line some one hundred or two hundred miles up the river; put in a steam plant so as to supplement their power and keep the pond at a constant level. Whenever a flood would come they opened up the wier and let the water pass out of it. Whenever they did not have water enough for power without lowering the pond too much, they started the steam plant. In other words, they went to an expense of many thousands of dollars and tripled the amount of anopheles that would otherwise have been produced. Well meaning but unwise was their practice.

The Parr Shoal pond in South Carolina in the same way was kept at a constant level by the United States engineers and was one of the worst breeding ponds I ever saw in my life.

What we recommend is to keep the water as high as possible during the non-breeding season—roughly, from October 1 or 15 until June 1 or 15 of the following year—and then lower it as much as could be economically afforded for the summer. Keeping the pond up, say three feet above the summer level, would kill all land grass, all land vegetation up to the level of the water. Lowering it in the summer gives it almost a perfectly clean bank. For the second year I think I can leave out the "almost." Naturally the drift, the floatage, and everything accumulating in the winter will land upon the bank and leave the water edge practically bare so that the fish can find the mosquitoes.

In addition, we asked that they would save every rise that came down. Instead of losing the water, which is worth much to the power company, they keep that dam closed and save the rise, and raise it two or three inches or a foot or two as they can, and then lower it again afterward. Whenever you make a mosquito move, the fish has a chance at him, whether from lowering the pond level or raising of the level. Also, when the freshet comes their floatage comes down. It will go to the bank and if that level is two or three feet above summer normal, then when the level is lowered again it will be left upon the bank stranded above water level.

This is the first time I have had an opportunity to see the effects of thave work. At Badin, in North Carolina, which both Mr. Hildebrand and Dr. Griffiths will agree, was at one time a bad pond when breeding anopheles, we had extremely good results. It is the American Aluminum Company's pond, and aluminum was selling very low. The manager asked what he could do to lessen malaria. We told him he did not need so much water this year; to lower his pond thirty inches; and he said he would do that. I

went there in August, and, in fact, stayed there from August 1 to August 20. I went over that pond with two assistants and found practically no anopheles larvae on the banks of the pond. The banks at the water's edge were clean and the gambusia had absolutely attended to the rest. Too much had not been left to them. I may say in addition that the manager there had planted a large number of gambusia, had two gambusia hatcheries, and practically every day in summer carried from five hundred to a thousand to the creeks in his pond. It is a well managed pond from a sanitary standpoint.

At the pond of the Southern Power Company, in South Carolina, the history is that there was a great deal of malaria there in 1920. I do not know about that. We saw the pond this year and it was ten feet below the summer average. I got there August 24 and every one knows that is the season when you expect anopheles to breed. Mr. Fisher, Mr. Boldridge and I worked on that pond roughly for two and a half weeks. We were able to hatch out three anopheles from the larvae we took.

That is the method to clean the banks of large ponds, to remove the protection of the larvae against the fish. I simply give that to emphasize Mr. Hildebrand's statement not to leave too much for your fish to do. By lowering the level of your pond, you have the water edge against a clean bank better than by two or three millions of dollars spent in hand cleaning, and this method costs nothing.

One thing that Dr. Griffiths said was noted: the death of fish in dry seasons. Mr. Fisher and I did some work in Bamberg, S. C., in 1919. It was exceedingly dry, and the health officer of the place—I think it was the mayor, not the health officer—took pains to cover heavily with oil every little pool, and there were not many of them in which any fish were left with life. I think it was perfectly certain that there was not a mosquito-eating fish left in Bamberg after the summer of 1919. Oil can do harm as well as good.

Mr. George Parker, Sanitary Engineer, Jacksonville, Tex.—There are two points which Mr. LePrince brought out in his paper that should be emphasized. One is the possibility of economical malaria control by the use of fish, a method available to all. We have the Gambusia affinis that perform their work without instructions, and as Dr. Carter, Mr. Hildebrand and Dr. Griffiths brought out, they need only the aid of the health officer or field director or whoever may be conducting the control work.

The second point is with regard to the Anopheles quadrimaculatus. We believe in general that this species of mosquito is principally responsible for the transmission of malaria in this country. We know that this mosquito, in its aquatic stages, will be found in still water, ponds and places of like nature. Such places are also the selected areas in which the gambusia lives. Therefore, we have a strong connecting link between the two which gives the fish the advantage. During the breeding months anopheles are generally found in such places, but not frequently are the fish found. So the body of

water must be stocked and the fish will thrive to the detriment of the mosquito larvae.

In one of the Texas towns that has carried on malaria control work for the past two years, statistics have shown that 75 per cent of the malaria cases among the town people were being contracted outside the control area. It was found, as a rule, that such cases were contracted while the person was on a fishing trip or some venture that exposed him to infected mosquitoes. The City Council of this town, Jacksonville, Tex., viewed the situation from two angles: first, that the citizens were going to continue to visit such areas and contract malaria; and, second, that the people who lived in these areas were directly connected with the town in a commercial way, that the town was their point of market distribution for their crops, etc., and that the personal welfare of these people directly affected the welfare of the town. It was decided to stock every known body of water within the surrounding one hundred square miles of the town with gambusia. The project was advertised in the local papers and the farmers requested to notify the health officer if there was water standing on their places. The cost of doing this work was about \$25.00.

In one of the counties of east Texas, a malaria survey is being carried forward at the present time with funds provided by the county Red Cross chapter. The purpose of the survey is principally educational, and the determining of the malaria rate by blood examination. There are seventy-one school districts in the county and to them this work is being extended. As one of the features of the survey gambusia hatcheries are being advocated. Each school district is being requested to establish and maintain such a hatchery, which is to be under the direct supervision of the school children. Very often the day after the recommendation has been made we have received word that the pond was ready and to provide the fish. By doing this there will eventually be seventy-one gambusia hatcheries in that county, covering an area of 1049 square miles and populated by 37,000 persons. As the gambusia are distributed by the school children and multiplication takes place, there will undoubtedly be a marked reduction in malarial fever throughout the entire county. The cost will be practically nothing and will be governed only by the cost of shipping the fish from the main hatcheries which the larger towns are supporting for their own control work.

Mr. LePrince (closing).—I think you will get the very best possible answer by following the suggestion I made of reading one or two bulletins that I referred to which you ought to read anyhow, written by Mr. Hildebrand. I am not going to answer your question, so as to make you read them.

I have mentioned the fact that all was not known that ought to be known about fish control,

and I find out I was right. Many very good points have been brought out.

It is probable that I am wrong in regard to the gambusia preferring anopheles to culex. But there are exceptions to all rules and I have run into 100 per cent exceptions. It may be in one state that they do not act the same as in the other.

The point brought out about the examination of birds' stomachs is rather interesting. We shot birds down on the Isthmus. In fact, we used it for proof as to mosquito flights. Before checking those flights we stained our mosquitoes and determined the field ranges. We thought we knew what we were doing. We did not at all. We carried this experiment out in the Southern states and then discovered a year or two ago what we were doing was to learn how to win the war. When the war came on we knew exactly how and where to operate, and the whole thing started from watching the birds.

But the thing can be overdone. I believe that the matter of the practical use of birds should be left to scientists to develop and for health officers to follow later. I am inclined to believe we have enough other insects than mosquitoes bothering the farmers, so the birds could be left for them. It is most unfortunate that the discussion which has been given here cannot get to more working sanitarians and county health officers all over the South. If funds cannot be provided for the printing of the proceedings, maybe some of you have some millionaire friends who would be delighted to become members of this Section and provide them. I do not think we ought to let such valuable information as this be kept away from the men who are out in the field today doing work for the benefit of humanity. It is a mistake.

Mr. Johnson (closing).—I think Mr. Komp has been very good to give us a description of the Paris green method. We must all agree that it is a most important method, because oiling is unsatisfactory. This method is in its place much more satisfactory and much less costly.

But there is one point which should be emphasized. In Alabama—and I believe it is the same generally in the South—there are many communities in which the people want to eliminate the pestiferous rather than the malaria species. You cannot get their support for eliminating the malaria mosquitoes unless you also control the other mosquitoes. The great trouble with the Paris green method is that it will get the anopheles and the anopheles only. It has no effect upon the more pestiferous species.

Until we can get the sentiment all over the South aroused to the fact that we can eliminate malaria by controlling anopheles and not bothering about other mosquitoes, we shall have to control those other mosquitoes. And until we find a better method for controlling them, we shall have to rely upon oiling.