

# WOODSMOKE®

VOLUME 1

\$1.25



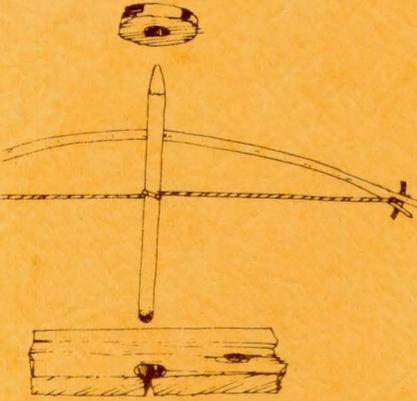
**INSIDE**  
Full details on 1977  
Outdoor Survival Courses



journal of outdoor survival  
and self-sufficient living

# OUTDOOR AUDIO-VISUAL TEACHING AIDS

Produced by the Highland Survival School



In the past few years there has been increased interest in various phases of outdoor living. This activity has prompted many schools to adopt new programs for **Outdoor Education.**

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## About Woodsmoke

Woodsmoke is a journal of survival, primitive living and homestead excellence. It was conceived first under the title of "The New Homesteader", but even before the first edition was ready to roll, we realized that a much broader scope of survival and primitive living was beginning to emerge, so we settled on Woodsmoke. The name tells it all from a primitive campfire in a remote cave to grandma's cookstove!

In the wilderness our view implies less dependence on sophistry with packed-in "kits" and gear from the outside. Self-reliance and survival with nature is the focus in the wilds.

On the homestead we believe in excellence of production and self-sufficiency using the best from all ages-even the space age. We will emphasize self-contained, energy efficient and independent lifestyles that lead to a greater oneness in purpose and greater unity as a people.

Woodsmoke will bring into your own world carefully and tastefully selected articles, news and adventure suited to all ages.

Woodsmoke #1 is our first. We like it and hope you will too. As in all beginnings we realize fully that quality and a more excellent product must come with each issue. You may help too, with your comment and suggestions, and by showing Woodsmoke to your friends. Maybe they'll want to subscribe.

There isn't another publication quite like this one, so we hope you enjoy it with us.

The Editors

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## the survival of purpose

by Larry Dean Olsen

**Man is not so simple an organism  
that he can be content to graze  
all of his life.**

Many people are reaching out into the country and wilderness for a re-identification with nature. At least one writer has said that this process amounts to an adolescent experience. Perhaps his reasoning lies in the observation that many have not yet gained a mature purpose for becoming self-sustaining.

I believe that man is a part of nature. If this is true, then it must follow that a part of man is sustained by the processes of natural living. Yet, too often the attempt to capture a natural life style fails. Human potential is sometimes brought down to little more than a poverty performance. Let us look at some levels of desire for independence and determine where the adolescent imagery gives way to a more mature view of man in nature and in society.

### Level 1

George Crankershank had finally thrown over higher education and decided that the "rat race" was too much to bear. He wanted to sweat with honest toil instead of sweating it out in the business world. So, with a determined will to become a back-to-the-lander and a sincere vow of poverty, he retreated.

Somewhere down the line, George gravitated from honest toil to shedding his educated sweat in some environmental or anti-corporate causes. Meanwhile, his own land stewardship became a veritable junk-pile of so-called self-sufficient living. It included a "salvage dwelling" which would be energy efficient, someday; a weed-patch garden which might provide edibles for about ten percent of his yearly food needs; a well-stocked library; dirty overalls (just dirt, no sweat); and a book of food stamps....

### Level 2

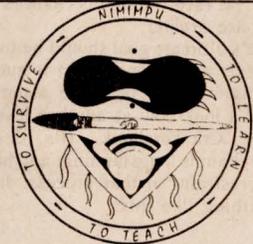
Dave Crankershank also left the boundaries of civilization to seek a oneness with the natural world. He spent many weeks roaming the hills to find the secrets of life, identifiable to him through the literature he packed along with him. The quest was sincere and is needed from time to time by everyone. However, all direction was inward as Dave scooped up the lessons of nature, and he soon dwelt solely in his world of unspoiled beauty.. →

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## Level 3

Frank Crankershank, out of concern for his urban-spoiled family, sold everything that fifteen years of hard work and keen wits had earned. He purchased his five acres and independence and moved to the country. Life style was important to him and the desire to sit and whittle soon gave way to some serious sweat to get things going. He was partially self-sustaining so long as he sacrificed some time at a job in town, usually outside his professional expertise. That was okay though, and his only real frustration was getting his family to make the shift from urban entertainment to country concerns for the weather, weeding and animal husbandry.

Gradually, however, his long-standing drive and umph tempted him to dip his hand back into the business world. He innovated ideas, services, and even products which through careful management actually contributed to others....

In each of these three illustrations, the individuals had at least one motivation in common--escape. They fled to a state where the important lessons and feelings of nature could be introduced, perhaps for the first time. All three used an adolescent approach, without any understanding of true INDEPENDENCE, which should be the major purpose for self-sufficiency.

The survival of purpose means that one must constantly look at his reason for stepping out of a cream-puff dependence into the sweaty world of self-sufficiency. There must be an awakening into a mature experience with self-reliant living.

What motivated George, of level one, to accept a life of self-inflicted poverty? He had read about simple, but non-excess-producing societies which have current appeal; and he believed that the purpose of life lay somewhere in that unstressful atmosphere. He unwittingly placed himself in the same dominated and dependent condition found in almost every poverty-level group around the globe. His position now is that of a non-producing recipient of the dole, and he is wide open to manipulation by governments and even by some radical pressure groups. He is actually far from being self-sufficient, even with his land and garden.

Dave Crankershank may be better off, since as a wanderer he possesses more freedom. But ultimately, if he makes it a permanent affair with nature, his lack of stewardship will restrict his ability to build a more settled and contributing life style later on. He may simply become another interesting, and perhaps colorful person for others to talk to in justifying their own deep feelings of escape.

Frank Crankershank may bust himself eventually unless his purpose is born of the strictest resolve. His return to what he considers the "rat race" would be inevitable, if his original motive was only to escape. On the other hand, if his major motive was to purposely eliminate the traps of that "rat race," then his chances for survival in a new life style are greater.

One's ultimate goal should be to develop a self-sufficient life style with purpose that is mature, not forgetting that the dignity of work is the major ingredient.

Let's look now at another level of independence with Victor Crankershank. His desire to become more self-reliant is longstanding, and his life has reflected some wise restraint in that process. Itemized, his efforts look something like this:

A. He has become educated formally and also through a continuing program of independent study, apprenticeships and practical experiences.

B. He has developed a useful, progressive, but undemeaning profession which enables him to be self-sustaining in a financial way, also. He is able to keep this profession alive and interesting without sacrificing his family ideals or his life style.

C. He allows for contingencies in the happy perspective of survival on the land by continually looking at his purpose for doing so. He knows the value of certain societal offerings, including a wise insurance program, proper medical protection and immunization, etc.

D. He maintains a fiercely-won freedom from debt and any dependency on agencies which may offer him assistance in the form of food stamps, free health clinics, price supports, grants in aid, public welfare, and any other monetary assistances. He shuns the dole in all its forms, thus maintaining his self-respect and freedom from those dependencies.

E. He has built for his own family a system of preparedness for unforeseen problems of poor health, occasional sickness, a lost job, natural emergencies, and possible social or man-made emergencies. To accomplish this he stores away in an efficient manner at least a year's supply of food, clothing and fuel. He maintains an active system of rotation and replenishing. The tale of the ant and the grasshopper has become a favorite fireside story to his family.

F. He has become an ensign to his neighbors rather than a recluse and assists them in raising their level of existence. Though he may be viewed as intrusive by some, his overall impact on the landscape will be one of progression and improvement.

G. He lives in such a way that salvage and recycling have become moral acts of thrift rather than dire necessity, and conservation has become a principle of integrity rather than a desperate concern. He cleans up his own ditch banks first.

H. He blends a creative nature and a sense of the "artist of the beautiful" with the practical acts of better water usage, necessary construction and other impacts on the land of his stewardship. His effort is to improve and beautify, keeping in mind and sight the natural scheme of things.

I. His time is the stuff from which life is made. It is managed not only to survive but to contribute to the good of all. He sees it as an ingredient for making ends meet and "for enough and to spare."

However we start out, there must be goals established which carry us beyond a so-called simple life style into a more complex and mature reality of one's purpose and relationship with nature, fellowman and the universe. I use the word complex to illustrate one undeniable truth: Man is not so simple an organism that he can be content to graze all of his life. He must cultivate, water, and tend to the qualities inherent in him to become one with nature. By so doing he understands better the principles which govern his level of independence from the unnatural. With understanding he cannot be driven from pasture to pasture by some manipulative agent of an "escapist" philosophy. The survival of purpose may very well determine which of all us Crankershanks will truly inherit the earth. Meek men are not driven around, nor are they continually fleeing the "rat race." But they do provide for their own, quietly and with a purpose.

# THE SPARTAN TRAIL

## A FIRST-HAND SURVIVAL ADVENTURE

by LEE NELSON

A step backward to cave man living gives strength and insight for better modern-day living.



Larry Olsen showing students how to uproot a plant with a digging stick.

The caravan stopped beside a dry wash. We were in the remote desert country in the sparsely populated southwest corner of Idaho. Eighteen of us piled out of our vehicles and scrambled down the steep bank.

At the center of the group was Larry Olsen, leader of the expedition and author of the best selling book, "Outdoor Survival Skills." He picked up a smooth black rock, a little bigger than a goose egg, and struck it sharply against another rock. The black stone split in half exposing a glassy flat surface.

"This is obsidian," said Larry. "Everybody get three or four pieces. You're going to need it for tools and arrow heads."

The group consisted of fourteen men and four women. We were headed into the remote Jarbidge River Canyon on ten-day survival expedition.

After a few more miles of open desert we reached the Jarbidge River. It was a clear, rushing stream, weaving its way among boulders and brush at the bottom of the canyon, past a hot spring resort, then along the river for a mile or two before crossing and weaving back up on top and across the desert. It was at this last crossing that we parked our vehicles and began our trek into the Jarbidge canyon. Ahead of us lay 90 miles of rugged, roadless country seldom used by man.

Before leaving civilization we had a final equipment inspection. Needless to say, it didn't take long. The required gear for each participant was a pocket knife and a blanket. No matches, no sleeping bags, no cooking utensils, no food, no air mattresses, no tents, no Coleman stoves, no hatchets, and no porta-potties, nor any of the other usual items often taken on camping trips.

Before rolling up his blanket each student received three small plastic bags containing whole wheat flour, brown sugar and raisins. Larry explained that this food would keep us alive while learning to live off the land. I could have eaten my total food ration in one meal.

As we began to wrap the food in our blankets, I noticed that the other students had thick wool blankets, pretty substantial-looking next to my polyester imitation that I'd grabbed off the bed on the way out the door. One of the students told me I was going to freeze at night because I didn't have a good blanket, and I began to worry that perhaps I should have purchased a wool blanket, but my worries soon disappeared when I saw Larry Olsen's thread-bare excuse for a blanket. I remembered something he once said about some students expending so much time and energy maintaining personal comfort that they neglected more important food gathering activities and the development of survival skills. I decided not to worry



Survival students reach camp site, a series of caves once inhabited by Palute Indians.

any more about personal comfort, I could always keep a fire burning all night if my blanket wasn't warm enough.

The sky was partly cloudy and threatening an afternoon thunder shower as we headed down the Jarbidge. We followed a deer trail that disappeared in places, then reappeared. Below the trail the river swirled in and out of deep green pools and curved around huge basalt boulders. Elusive trout darted here and there across the quiet pools, an indication that many more were resting quietly in the green depths.

The hiking was easy, no heavy packs to make shoulders and necks sore, just a blanket and for me, a five-pound camera case.

I pondered my reasons for coming on the trip. I had known Larry Olsen for several years and had even written articles about his courses. I guess it was in writing those articles that I discovered a fascinating aspect about the courses that compelled me to become a participant.

When Larry first started teaching survival courses at Brigham Young University ten years ago, students who had flunked out of the University and wanted to be readmitted, were permitted to do so provided they first took Larry's survival course. Of these dropouts or flunkouts who took the course and re-entered the University, nearly all graduated in their chosen fields, some with honors. What had the survival course done to these students to cause such a dramatic turn-around in their college performance?

Once when Larry had finished giving a lecture a man had grabbed him by the arm and demanded, "What did you do to my boy?"

"What do you mean?" asked Larry, knowing that no one had ever been killed or seriously injured on one of his trips.

The man then described some of the changes that his young teenage boy had undergone while taking one of Larry's courses. The boy who had once been a fussy eater, now eagerly devoured everything on his plate. The boy who had once been reluctant and negligent in doing his household chores, now did them willingly and cheerfully--taking out the garbage, mowing the lawn, making his bed, etc.

It was easy for Larry to explain to the father why his boy had learned to appreciate the food his mother cooked. After living on a survival diet of wild roots, bugs and rodents, even the blandest bowl of oatmeal became a feast fit for a king! But explaining the boys increased productivity in accomplishing his household chores, and his improved attitude towards work, was something Larry could not verbalize. College flunkouts had become straight A students after taking his course. Entrepreneurs found courage to undertake new ventures. Drifters found purpose and direction. Businessmen and salesmen became more productive. Timid and reclusive individuals found new confidence and enjoyment in dealing with other people and were able to make enduring friendships with fellow survival students. In some unexplainable way, Larry's survival courses seem to fan into a brighter flame that spark of life that lies smouldering quietly in every heart.

Larry and I had often discussed the therapeutic effects of survival trips trying to pinpoint the cause of the dramatic improvements made by individuals while taking the course.

As I hiked down the trail into that remote canyon, these are some of the thoughts that occupied my mind. It was exciting to think that perhaps during the next few days I would uncover some of the secrets of human motivation

and self-actualization.

My interest in these questions was more than a mere intellectual curiosity. There were areas of turmoil in my own life where I needed more strength and insight. I was unhappy with the quantity and quality of my writing. My business wasn't running as smoothly or making as much money as I felt it should have. And because of business pressures I had found myself becoming overly irritable and cross with my family. Maybe the survival experience would help me too, I hoped.

After hiking along the river for a few miles, we reached an old sheep bridge used by herdsmen years ago. It was one of the few places along the rugged Jarbidge where herds could get down to the water's edge from either side.

Larry walked down to the river's edge, picked a dry, reddish-brown stalk, and called us around.

"Dogbane," he said, "It's a close relative of the marijuana plant. I wouldn't advise using it like marijuana, however. The Paiutes used it to poison the enemies. First you're high, then you die!"

He twisted the stalk into shreds, explaining that the outer fibrous bark was a durable cordage material for making string and rope. He told us to harvest some of the dry stalks to bring along since he didn't think any dogbane was growing near where we would be camping. We would need cordage for our animal traps.

We crossed the sheep bridge and toiled up a steep rocky trail to the sprawling sagebrush prairie above. Along the way Larry pointed out various edible plants--biscuit root, sego, arrow-leaf, balsamroot, thistle, wild onion.

He also called our attention to some edible animals--rock chucks, field mice, jack rabbits, carpenter ants. I wasn't hungry enough to take much interest in the latter.

The desert above the canyon was cold and windy. Larry demonstrated various ways to keep warm without fire. Everyone sat in a tight circle with their feet in the middle, a blanket tossed over the top, and it was warm and toasty inside--without a fire.

Larry said if one sprinkled Cayenne pepper in his boots, the foot sweat would react with the pepper creating heat to keep the feet warm.

"Then at night," he said jokingly, "Just take your socks off and toss them in the soup kettle."

After crossing the prairie we dropped into a canyon that led back to the Jarbidge River. Along one side of the canyon, at the base of an overhanging cliff there were a number of caves.

We spread out along the cliff selecting our new homes for the coming week. I found a hole in the rock that opened up into a nice roomy fourplex, which I shared with Dalton, Frank, and Barry.

We scraped the floor smooth, finding several bone and obsidian chips in the process--remnants of the Paiute Indians who once inhabited the area. Then we carried in armloads of dry grass and brush for bedding.

When the cave was ready for habitation, we returned to the main cave for instruction of fire building. Dick Jamison, Larry's partner showed us how easy and fast it is to build a fire with a bow drill. He merely stroked his bow back and forth until there were little clouds of smoke billowing away from the base of the spindle. Then he dropped the spark into a bundle of ruffled sage bark and dry grass, puffed into the bundle until it burst into flames.

It wasn't until a few minutes later when we were all trying to make our own fires that we discovered the process not to be as simple as it appeared to be. After numerous failures, it wasn't until two days later that I was able to start my own fire without matches.

After wearing our arms to rubber in unsuccessful efforts to make fires, most of us borrowed sparks from Dick to start our campfires. Then came the hard work of the day--hauling up firewood from the bottom of the draw. What made the work hard was that it was after 8 p.m. and no one had eaten a meal since early morning.

When the night's supply of wood was gathered, we began cooking and eating our late supper, consisting of ash cakes and raw edibles gathered on the way in.

I remembered reading Andrew Garcia's account of the ash cakes made by his Nez Perce wife in 1878. Garcia didn't give the recipe beyond the mention of flour and dirt which seemed to be common ingredients. He did say that they felt good on an empty stomach, in spite of the dirt.

Following is a recipe for ash cakes.

1. Mix flour with water to make a ball of dough about as big as a golf ball (Sometimes I added a little brown sugar and a few wild onions for flavor).
2. Knead the ball of dough for a few minutes gradually working it into a flat cake, somewhere between a cookie and a tortilla.
3. Toss it onto the hot ashes near the edge of the fire, turning it several times and being careful not to burn it.
4. Let it cook for five, ten or fifteen minutes or until you are too tired to wait any longer, knock it out of the fire with a stick. Then, handling it like a hot potatoe, dust the ashes away and begin eating.

Garcia was right, they are good--when compared with the alternative of going hungry. I don't imagine, however, that a camper with a plentiful supply of bacon, eggs, steaks, peanut butter, candy bars, and jerky would develop much of a taste for ash cakes.

Ash Cakes are a definite help to the serious survival student wanting to learn to live off the land. After two or three days of eating nothing but these dusty little wafers, the wild foods from the land become more and more desirable--mice, snakes, dandelions, grass, thistle, etc. I doubt that a student with a pack full of civilized food could ever develop an honest appetite for these kinds of foods, but after a steady diet of ash cakes it is amazing to discover the broadening range of wild things that will cause the salivary glands to start functioning.

Another nice thing about ash cakes is that it doesn't take very many to satisfy one's hunger. During the entire trip I never ate more than two at one meal. A pound of flour goes a long way.

As we relaxed around the fires after dinner it was interesting to note how the various conversations invariably ended on the subject of food. At one point Dalton held his arms out in front of him as if he had hold on a 40-pound watermelon. He described in salivating detail how he would split the melon open on the rock in front of him, then slash out the big red juicy heart--sweet, wet and cold. Then someone else described a Chinese dinner--fries rice with bits of egg and ham, sweet and sour pork ribs, mushroom chow mein, deep fried prawns. Then someone else interrupted with a description of a favorite Mexican dinner--chicken enchiladas, refried beans, guacamole.

Sometimes the conversation would turn to other matters. Larry told of the Jarbidge Savage, the huge manlike creature after whom the canyon was named. Before the days of the white man, the Jarbidge Savage supposedly roamed the canyon, ambushing unsuspecting Indians and eating them.

I didn't sleep much that first night in the cave. I wasn't really cold. The blanket wasn't much good, but the Patagonia pile sweater I had obtained at the Bitterroot

Backcountry Store in Hamilton kept me plenty warm from the waist up and my bed wasn't uncomfortable, with all the dried grass underneath. I just wasn't sleepy, and neither was Dalton. Frank and Barry were snoring loudly after only a few minutes in the sack.

Dalton and I stayed awake all night, discussing various subjects. About 3 a.m. we stoked up the fire and he showed me how to make string from dogbane stalks.

As the sky started to turn gray with the dawn, I crawled back in the cave to get a little sleep. Dalton stayed by the fire. When I returned to the fire after a little nap, Dalton was curled up like a kitten, sound asleep. I put another log on the fire, and since it was almost light, decided to do a little exploring.

I headed down the draw towards the river. The clucking of prairie chickens echoed back and forth across the canyon walls. After about three quarters of a mile, I came out on an open saddle and saw what could easily be called the Grand Canyon of Idaho--vast expanses of red cliffs with the sparkling Jarbidge River winding through the bottoms like a disheveled silver ribbon.

A few minutes later I discovered what could easily be called a survival student's treasure. Under an overhanging rock, near the ashes of a deserted campfire, I found a pair of discarded fishing boots, a pair of work shoes without shoe laces, a pair of trousers and two one-gallon bait cans, one with a handle--a perfect stew pot as soon as the dried worms were scraped out.

The rules of the trip were that, even though we couldn't take any modern conveniences with us, we were allowed to use and keep anything we could find on the trail. I loaded up my treasure and headed back to camp. There were clam or muscle shells here and there along the bank of the river. The leaky waders could be worn while digging the clams. The bait cans would do nicely as cooking kettles for the chowder, and the extra pants would provide a dry change of clothing while my wet clothing dried by the fire.

After a tasty breakfast of ash cakes and a handful of raisins, Dick taught us how to build Paiute deadfalls out of dogbane twine, willow sticks and flat rocks. Using Dicks trap for a pattern, the students set to work building their own. By nightfall over a dozen traps were set in the canyon. The first successful trapper was Nancy Jenkins from Los Angeles. She caught a rabbit.

Some of the men got a rabbit about the same time by cornering it under some bushes and clobbering it with throwing sticks and rocks. Under civilized conditions, such hunting might seem cruel, but in a survival situation where no one has had a good meal for several days, capturing a rabbit under any conditions is a heroic event to be celebrated and bragged about around the campfire.

On a later exploring adventure, while setting traps, I discovered two caves. The floors were piled high with aging clam shells and obsidian chips. I wondered how many generations of Indians it had taken to cause such an accumulation of shells. I poked around in the piles of shells for a while hoping to find some artifacts, but only a few bone chips turned up.

Earlier I had failed to find any muscles in the river, but after discovering all the shells in the cave it was obvious that Indians had lived for a long period of time on the shellfish.

I returned to the river, dug in the sand, in the gravel, in the rocks, in the shallow places, in the deep places, in the fast water, in the slow water. I looked for bubbles and bumps and rubbed my hands raw in the sand and gravel,

but never found a single muscle. I began to think that maybe they reproduced in cycles and that it was my tough luck to be looking for them at the wrong end of the cycle.

In the meantime, I had found a piece of a log with some nails in it. Using my knife I pried out one of the nails, fashioned it into a fish hook and sharpened it on a rock. I unraveled a piece of nylon string from the cord that held my blanket together and attached the line and hook to a limber willow stick. For bait I used a piece of ash cake dough.

I dropped the outfit into some deep turquoise water behind a big boulder. Before the bait had sunk more than a few inches into the water, two fish darted out from under the rock and stole the dough. The nail wasn't sharp enough to hook them.

As I began making improvements on my fishing tackle, and as other students heard about the prospects of fresh fish, some interesting improvements showed up from hidden corners in packs and pockets--a little gold hook, a piece of mono-filament line and two lead sinkers.

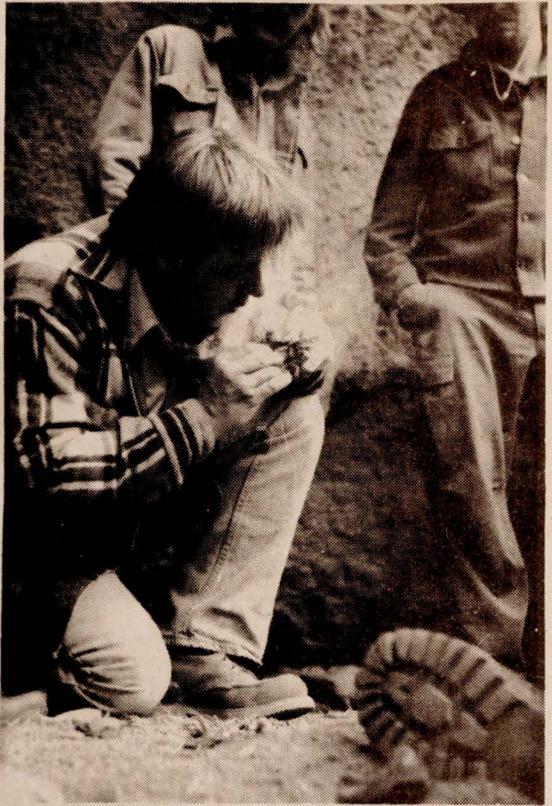
That night everyone had a fresh roasted fish for dinner. The fish were roasted on sticks, like hotdogs at a weiner roast. Dalton and Larry ate the heads and bones. I had been so busy searching for food that I hadn't paid attention to my hunger, and even as my fish roasted I didn't seem to be very hungry until I took the first bite. It was still raw, but I ate it anyway, not wanting to wait for the few more minutes of cooking it needed. It was delicious, and I swear that as I ate it I could almost feel the strength of the fish flesh entering my bloodstream with each swallow. After a few days of meager rations, one's digestive system becomes extremely vigorous. In fact, all body functions seem more alert and intense after several days of meager diet. There is no question in my mind after taking this survival course, that in every-day life most of us through over eating, keep our bodies in a state of overfed sluggishness.

Some of the students boiled up big stews of roots and greens, others feasted on rodents and snakes. The favorite items in my diet were fish, onions, dandelion tea and ash cakes.

After the first night, Dalton and I didn't sleep in the cave anymore. We curled up in our blankets around the fire just outside the entrance of the cave. Monte Fuller joined us after the first night and we took turns keeping the fire going. Sometimes one could get an hour or two of uninterrupted sleep. After the second night, the grass padding under the blanket didn't seem to matter anymore. I seemed to sleep just as well on the bare ground. The thing that amazed me was that I always felt great in the morning--rested and refreshed, ready to begin the new day.

About half of our time was spent gathering food, the other half learning skills. In addition to making fires without matches, building animal traps, learning to recognize and harvest plants, we learned the basics of obsidian chipping to make arrow heads and tools, bow making and the fashioning of other tools such as throwing sticks and digging sticks.

Probably the highlight of the trip for me was when I finally made a fire without matches. Three or four of the other participants had been coaching me for two days. They all had different tips to give--a better way to position my body, how to apply pressure on the spindle as the smoke started to come, how to smooth out the bottom of the notch so the spark wouldn't catch, how to hold and squeeze the tinder bundle so the spark had the best chance



**Dick Jamison gently blows spark into flame. The spark was made in a bow drill, then deposited into the tinder bundle in Dick's hands.**

to start a fire, and much, much more. Starting a fire with a bow drill requires a lot more skill than one would think. And when I finally got a fire, everyone cheered as if I had just achieved one of the major accomplishments of my life. A great experience.

The backgrounds of the other students were varied and interesting. There were several writers, a graduate student of psychology, a rough neck from the Wyoming oil fields, an ex-IBM marketing manager, a Colorado cabinet maker, a cashier from Los Angeles, a North Carolina mountain man, two high school students, some just plain drifters, and a fellow who had had a successful bootleg operation in Africa. The fireside discussions on anything and everything lasted for hours.

As we headed back up the Jarbidge River at the end of the course, I reflected on the events of the trip and the possible consequences on me and the other students. My thoughts returned to the question that had concerned me at the beginning of the trip, about the changes people underwent while taking survival courses.

First I considered the physical changes. My body was alert and intense--not only the digestive system, but eyesight, hearing, reflexes. The lack of food, rigorous exercise and possibly fresh air had sharpened all my senses, and even though I had eaten only about one-fourth of what I normally ate at home, I felt strong enough to climb at a moments notice any mountain around. It was the same sense of physical well-being I had experienced after



Larry Olsen inspecting obsidian arrowhead he just secured to rose wood shaft.

completing basic training in the U.S. Marine Corps when I was 19.

There were some mental changes too that had taken place. During the survival course, all the complexities of normal civilized living had been removed. Life had become very simple. Most thinking and decision making was centered around gathering food, keeping warm and learning skills to increase one's ability to survive. There was no complex camping equipment to figure out, no long check lists of materials and supplies to keep track of. Life was simple and direct, it was easy to make decisions. If I couldn't find clams, I went fishing. If the fish weren't biting, I set rodent traps. When the supply of wild onions in my right pocket was gone, I dug some more.

In the complexity of our modern world, and because of the numerous implications involved in many of our decisions, it can become increasingly difficult to make decisions. In the simplicity of the survival situation it becomes easy to make decisions again, and as one gets in the habit of making decisions in the survival environment, he becomes more confident in making decisions in the complex world outside. At least this is what happened to me. As I hiked out on the last day and began to turn my mind to some of the problems of the outside world that I

had been wrestling with prior to the trip, I found myself making decisions that had eluded me earlier.

But probably the greatest advantage of the survival trip is not the physical state of sharpened senses and reduced weight, nor the mental advantages just discussed, nor even the skills learned that may later save one's life. The greatest advantage, as I see it, is the toughening process resulting from the spartan life. Some call it character or inner strength. Not being able to fill your belly when you are hungry, not being able to flop down on a soft mattress for a good night's sleep when you are tired, not being able to change into clean dry clothes when it's cold and dark and you are soaked from a recent endeavor to catch a fish for dinner. The deprivations of survival camping toughens one's body, mind, and spirit, and this toughness can't help but carry over into the outside world--making one a more astute businessman, a more serious student, a more disciplined writer, a more intent individual in every aspect of human endeavor. The hardships and challenges of the trail help fan that spark of life into a more brilliant flame.

As we approached the end of the trail where the cars were parked, I felt regret that the survival experience was over so soon. I knew that what I had done was worthwhile and would have lasting effects on me and my family.

# PRIMITIVE LIVING EXPEDITIONS

Summer and Fall, 1977

As the author of the bestselling book, "Outdoor Survival Skills," I receive numerous letters and calls from individuals who want to participate in a primitive living experience. As a result, we are offering a variety of primitive living and survival expeditions. These award winning programs are not matched anywhere in quality of experience and skills development.

When I add up the time I have spent on the survival trail of primitive living, it comes to almost ten years. During this time I have led over 3,000 students through the wild places of North America and in addition to the learning of survival skills, I have witnessed dramatic improvements in character and emotional stability, particularly among young people who have taken my courses.

Expedition students benefit in three ways. (1) **Skills Development.** Students learn the skills of living in the wilds with nothing to begin with but their own wits and hands. (2) **Physical Conditioning:** A lot more than physical exercise. A combination of rigorous physical activity, a change in diet from plenty of rich food to a small amount of simple plain food, and a new mental condition create a sense of physical well-being never experienced by most people in our modern society. Students often experience a sharpening of the senses and the release of latent energy and strength they never knew existed. (3) **Character Development.** It's tough to generalize here, every student is different. But when a student departs on one of our primitive living expeditions he is entering a completely

new world and leaving the old one behind. Call it escape, change of pace or what you will, the transition is dramatic and complete. He gains confidence in his own self-sufficiency as he learns survival skills and experiences the physical conditioning mentioned above.

Life on these primitive expeditions is plain and simple--keeping warm and finding something to eat. The complicated world that was left behind a few days earlier seems distant and remote, and as the survival experience continues the monstrous problems of the outside world gradually take on more manageable proportions.

These courses, however, are not for everyone. They are rigorous, difficult and challenging. They are for the serious individual willing to sacrifice the comforts of modern living in order to develop skills and knowledge leading to greater self-sufficiency, explore the limits of mind and body, and find deeper understanding of self and others.

If these are the kinds of things you are interested in, you'll probably want to register for one of the following Primitive Living Expeditions or other special programs we're offering in 1977. The number of participants in these courses is limited however, so if there is one you would like to be a part of, please let us hear from you soon.

*Larry D. Olson*

## PRIMITIVE LIVING EXPEDITION



This is our main survival expedition and offers the broadest range of instruction and practice in outdoor survival skills. Equipped with little more than pocket knives and blankets, students hike into a primitive area and establish a base camp. Here they learn how to build fires without matches, construct animal and fish traps from sticks and wild fibers, recognize and harvest edible and medicinal wild plants, fashion primitive weapons from bone and stone, learn to cook like a cave man and much more!

The learning atmosphere about the camp is relaxed, but effective. With trapping for example, after a brief period of instruction and demonstration, the students gather materials and begin construction of their own traps with an instructor nearby to answer questions and give necessary coaching. As soon as the traps are finished the student learns how to use them by establishing his own trap line.

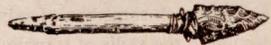
You will be given a small ration of flour or corn to supplement your diet of wild foods and make it easier for you to keep your strength up while learning to live off the land, yet the plain taste of the cooked grain will not hinder you in developing a taste for the wild things you harvest.

Some things you'll probably want to do together with other students; maintaining a fire, cooking, checking trap lines. But the specific skills you will learn to do by yourself, starting fires, carving digging tools, chipping arrow heads, etc.

Many of these skills you'll work on around the campfire at night while enjoying friendly conversations with fellow participants and instructors.

At the beginning of the expedition you will be given a personal journal and be required to write in it daily, so that when you return to civilization you'll have a lasting record of what will have been one of the most memorable and beneficial experiences of your life.

## STONE WORKING PRACTICUM



A unique and intensive experience in the ancient arts of making stone tools. This course will be taught in a primitive camp setting in the Bitterroot Valley near Hamilton Montana. Participants will receive instruction and practice in the following:

blade and core tools; flake knives, scrapers and other tools using only hammerstones and antler batons.

**Pressure flaking:** Selection of stones and blanks; pressure flaking methods for fine and delicate flaking of arrowpoints, knives, drills, eccentrics and other items useful in a survival situation. Several methods and types of antler tools are taught.

**Percussion flaking:** learn how to prepare the rough stones for striking off razor sharp cutting tools and blanks; make

**Pecking and Grinding:** Wet grinding and pecking with hammerstones to produce all types of stone grinding implements, metates, manos stone, ax heads, mauls, clubs, and tanning stones; proper stone selection and pecking tool preparation are emphasized.

**Hafting Methods:** How to mount stone tools onto handles or shafts using pitch, sinew or plant fibres. Special

attention is given to beauty and design as well as serviceability.

**Other Specialized Skills** included in the practicum are: Identification and selection of the best stones, wood and bone for tool making; plant fibres and the making of cordage; how to use stone tools for cutting, butchering and hunting.

## WILDERNESS HORSEBACK EXPEDITION

In addition to the basic survival skills taught in all of our programs, this expedition will emphasize back country horsemanship. You will spend the first day at the 2600 acre Rennaker Ranch north of Darby, Montana, where you'll learn about handling saddle and pack animals and be assigned a horse suited to your level of riding ability.

Early the next morning you will ride your horse up one of the most scenic alpine trails in North America. You'll be traveling light, like the Indians and Mountain men did over a hundred years ago. Except for a little flour or corn, you'll be living off the land--fish, small animals, berries, roots.



As you sit around the campfire practicing survival skills or preparing wild food, your horse will be grazing peacefully in a nearby meadow, ready to carry you further into the wilderness to fish, trap, pick berries or just explore.

When you return from this expedition you'll have mastered the basics of primitive survival and will know how to handle a horse on extended back country trips.

## PRIMITIVE HUNTING EXPEDITION

This is a once in a lifetime wilderness experience emphasizing the manufacture of stoneage weapons, hunting and stalking, and the utilization of animals after the kill--

The base camp will be a tepee village in a remote, back country area of scenic Western Montana. Participants will subsist on ashcakes, fish, wild plants and small animals until the first bow hunter (with valid license and tags) brings down an elk or deer. Then the entire camp will feast on sizzling ribs, smoked tongue, loin roast and other favorite Indian cuts while learning to tan hides, jerk meat, and manufacture numerous useful items from the hooves, bones, antlers, and various internal organs. You will learn first-hand how primitive men utilized the entire animal. Nothing will be wasted.

There will only be one section offered, limited to no more



than fifteen participants, including three or four good bow hunters with the necessary Montana hunting license and tags (\$115 for non-residents).

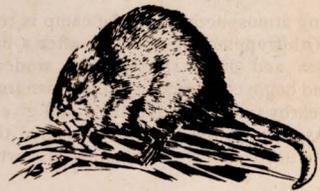
If you are interested in participating in this fantastic hunting experience, as either a hunter or non-hunter, let us hear from you soon. Applications will be accepted on a first-come basis.

## SNAKE RIVER TRAPPING EXPEDITION

Primitive methods of trapping game for food and furs is an art worthy of some special attention. This expedition will take place in a semi-remote area of Southern Idaho. Each participant will spend several days learning how to construct a variety of primitive traps and where to set them. Then each person will be involved in the operation of trap lines for the last five days of the expedition.

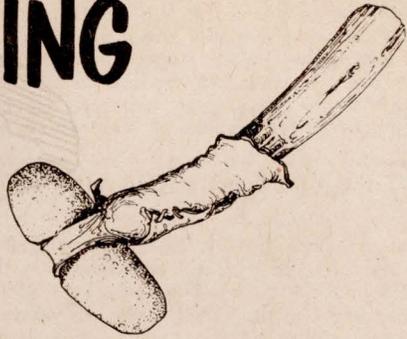
The main camp will be primitive and oriented to survival living although some basic foodstuffs will be packed in. In addition to the skills of trapping, detailed instruction and practice in making jerky and pemmican, processing and tanning furs, stretching, graining, and construction of useful tools and clothing from hides and furs. Related survival skills will also be taught.

The area used for the experience is along the Snake River



in Southern Idaho. We will be using canoes to navigate portions of the trapping area and also move inland to rugged desert canyons where small animals abound including bobcat, coyote and badger. Emphasis will be on food procurement as well as fur trapping. This means that the catching of food animals such as rabbits and fish will also be taught.

# PRIMITIVE LIVING EXPEDITIONS



P.O. BOX 59

STEVENSVILLE MT 59870

Please accept my application for the following:

## PRIMITIVE LIVING EXPEDITIONS

- |                                     |       |                          |
|-------------------------------------|-------|--------------------------|
| July 11-16 Montana                  | \$177 | <input type="checkbox"/> |
| August 22-27 near Yellowstone,      | \$177 | <input type="checkbox"/> |
| September 12-17 Montana,            | \$177 | <input type="checkbox"/> |
| October 10-19 [full 10 days] Idaho, | \$267 | <input type="checkbox"/> |

## STONE WORKING PRACTICUM \$177

- |   |                          |
|---|--------------------------|
| August 1-5, 1977, Stevensville, Montana | <input type="checkbox"/> |
|---|--------------------------|

## WILDERNESS HORSEBACK EXPEDITION

- |                      |       |                          |
|----------------------|-------|--------------------------|
| August 8-13, Montana | \$277 | <input type="checkbox"/> |
|----------------------|-------|--------------------------|

## PRIMITIVE HUNTING EXPEDITION

- |                          |       |                          |
|--------------------------|-------|--------------------------|
| September 19-24, Montana | \$277 | <input type="checkbox"/> |
|--------------------------|-------|--------------------------|

## SNAKE RIVER TRAPPING EXPEDITION

- |                      |       |                          |
|----------------------|-------|--------------------------|
| November 14-22 Idaho | \$290 | <input type="checkbox"/> |
|----------------------|-------|--------------------------|

Name \_\_\_\_\_ Age \_\_\_\_\_ Phone \_\_\_\_\_

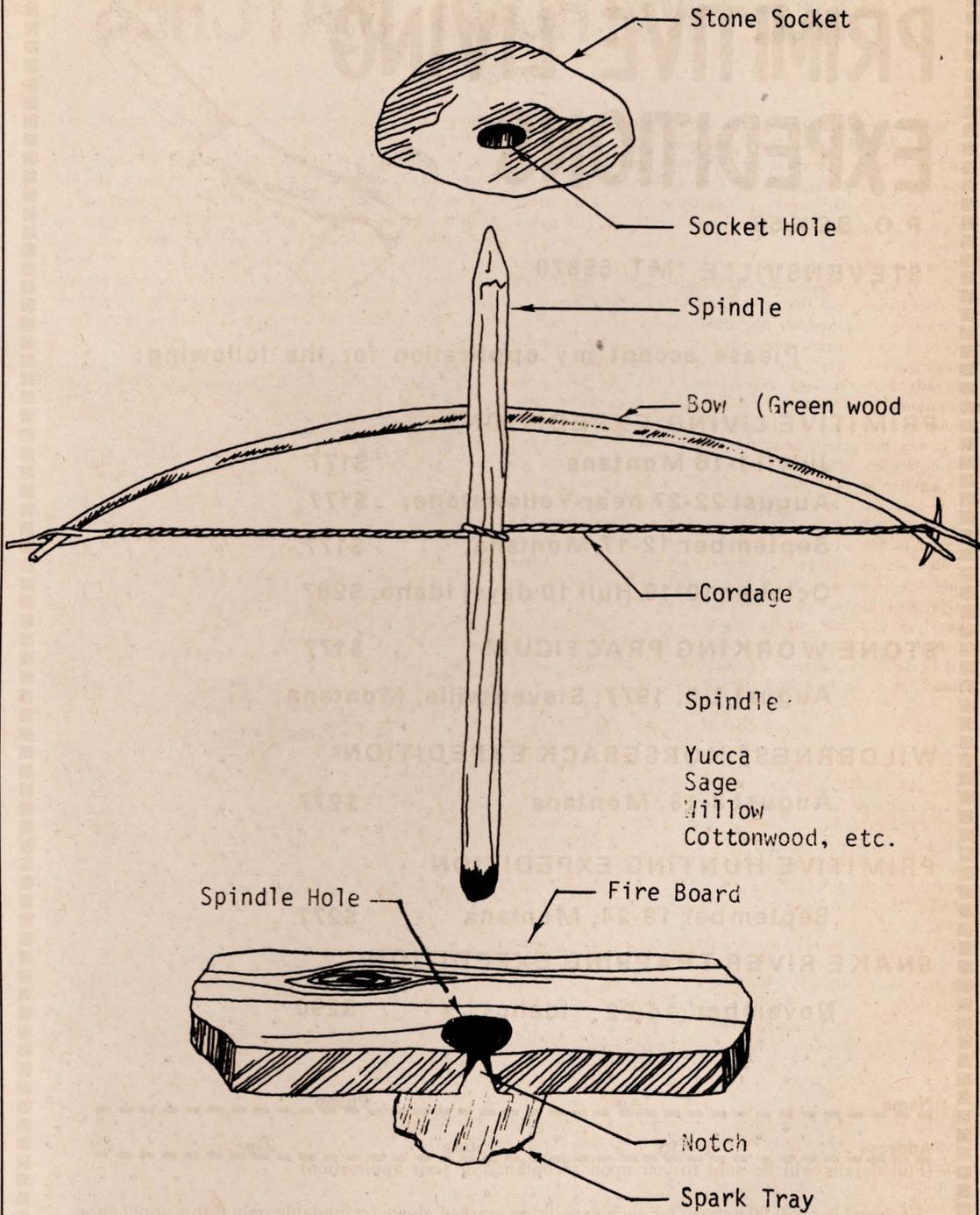
Address \_\_\_\_\_ City \_\_\_\_\_ State \_\_\_\_\_ Zip \_\_\_\_\_

(Full details will be sent to you upon acceptance of your application)

Enclosed is a \$50.00 deposit for each expedition marked above (refundable only if this application is rejected). I certify that I am in good health and will abide by the standards established by the expedition leader.

Signed \_\_\_\_\_ Date \_\_\_\_\_

NOTE: If you prefer no to cut this page, you may order on a separate piece of paper.



Bow drill

# FIRE WITHOUT MATCHES

by Al Sands

Jim and I tromped through the snow to a small cave in an overhanging cliff. We were still many miles from camp and my ankle was sprained. We were going to have to spend the first night of deer hunt without our warm sleeping bags. The tiny cave was dry and afforded a break from the wind, but the temperature inside was still below zero.

Jim started breaking branches from an old dead juniper nearby, and I scraped together some tinder from a rat's nest at the back of the cave. Confident we would soon be warm, Jim reached for his matches. He always carried them in a waterproof container in his hunting bag, but for some reason they just weren't there this time! I had already lost my bag several hours before, trying to outmaneuver a buck on a windswept ridge. After three thorough searches of our pockets, still no matches.

It was our good fortune to know what to do in such emergencies and without a word, Jim headed down the hill to a patch of dry willows near the river. I took off my boot-lace, cut a branch from the juniper tree, picked out a small stone from the floor of our cave and rearranged my tinder bundle. In a few minutes Jim returned with two willow pieces. We put together a bow drill set and in five minutes we were warming ourselves beside a blazing fire.

Not many people really believe it can be done. Yet, in a survival situation where matches have been lost or exhausted, a bow drill may be a lifesaver.

A bow drill set consists of five parts: a fireboard, a drill, a hand socket, a bow and a tinder bundle.

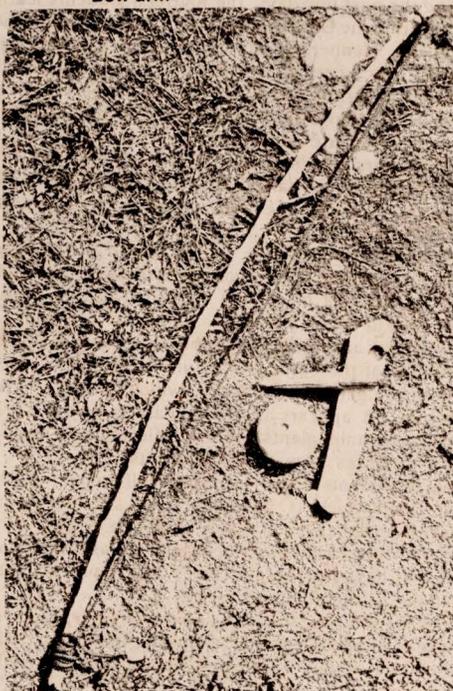
to apply a slight pressure, the bow is then drawn back and forth steadily.

After plenty of smoke appears and a conical pile of ground-off dust is formed under the notch, the drill is carefully lifted off the fireboard and the smoking pile of dust on the chip is carefully transferred to the tinder bundle where it is gently fanned and blown into a flame.

Because Jim and I had mastered the skill of making fire without matches long before our hunting trip, we were in no danger of freezing. You might say that our knowledge of making fires with a bow drill had saved our lives that night.



Bow drill



1. **FIREBOARD:** Made from sagebrush, cottonwood, yucca, willow, or other soft woods **except pine**; 10"X2"X½" thick. Carve a small depression near one edge. Cut a notch in the side of the board reaching to the center of the depression. The notch should be wider at the bottom of the board.

2. **DRILL:** Use same woods as the fireboard; straight cylindrical shaft 8" to 12" long and ¼" in diameter. Sharpen the top end to a pencil point and leave the bottom end blunt.

3. **HAND SOCKET:** Small stone, bone or hardwood; roughly 2" to 3" in diameter and flat so as to fit the palm of the hand. Make a small socket depression in the center of one flat side to receive the pencil point of the drill.

4. **BOW:** Any small branch or willow; green, about 20" long; thong or bootlace about 30" long. Tie string to bow as illustrated.

5. **TINDER:** Sagebrush bark, juniper bark, cottonwood bark, thistle down, firn plant fibers, etc. Gather **dry** bundle and rub between hands to fluff and shred the fibers, then form into a small bird's nest.

To use the bow drill set, the fireboard is placed on a flat chip of bark or wood. The spark will form in the notch and fall onto this chip. The proper position for working the set is to get down on one knee and place one foot on the fireboard to hold it steady. The drill, with the bow cord twisted around it, is placed in the fireboard depression. Using the hand socket on the upper sharp end of the drill

# OREGON GRAPE Nature's Yeast



Upon arriving at the new campsite in Eastern Idaho we discovered an abundance of Oregon grape. The tiny purple fruits looked refreshing and tasty after more than a week on the survival trail. Immediately several of the less experienced students dropped to their knees and began shoving the juicy berries into their mouths. The resulting puckering and spitting soon revealed an important truth about Oregon grapes--they are too tart for raw, off-the-vine consumption.

During the next few days, the fourteen students learned to incorporate the Oregon grapes into their diets in a more harmonious manner. When mixed with thimbleberries they taste much better, and help extend the consumption of the less plentiful species of berries in the area. They also make a cooling drink similar to lemonade, especially if wild raspberries are added as a sweetener. Cooking the fruit with other plants and berries subdued the tartness and improved their palatability. The Blackfoot Indians often used Oregon grapes to flavor their blood puddings and meat stews.

One of the more creative students used the berries to make a bright red dye to color his throwing stick. The yellow root can be made into a dye too--giving a bright yellow hue to faded T-shirts.

The students also learned that the white powder covering the outside of the berry is a natural yeast. This yeast is found on juniper berries, aspen, willow and the bark of other trees. It appears that the yeast is in the air and settles on certain plants. When collected and properly used it produces some exciting results.

Survival students usually carry a small amount of whole wheat flour which is generally eaten in the form of ashcakes--an unleavened wafer of dough cooked on hot ashes. Anyone who has subsisted on ashcakes for a number of days heartily welcomes any improvements or deviations to the standard recipe.

We decided to bake bread, using the Oregon grape yeast to make a sourdough starter. Someone found a jar which we used as a container to mix about a dozen of the whole

berries, approximately a cup of flour and enough water to make a smooth paste. The lid was tightly secured and the mixture had to be kept warm. One of the students was assigned the task of keeping the starter warm, he even slept with it at night to keep it from cooling. The little sugar in the berries helped activate the yeast.

After two days, we could tell by the tiny bubbles that the starter was active. We built a stone oven about 18 inches high and two feet across. At the bottom were hot coals from our sleeping fire. A flat stone was placed inside the walls for the bread to lay on, and another about the same size was layed on top in such a way that we could control the heat by removing it occasionally.

A cup of starter was mixed with about six to eight cups of flour and left to rise. It took three hours to rise one and one-half inches, longer than is normal with regular yeast. It was placed in the oven and baked about one hour. The result was two beautiful loaves of sourdough bread!

And as for taste, it was warm, moist and flavorful--the perfect compliment to our evening meal of smoked trout, watercress and lambsquarter salad, and a dessert of thimbleberry ashcake turnovers.

Needless to say, the starter was soon used up and had to be replenished by adding more berries and more flour. A little more liquid mixture of the dough made great sourdough hotcakes that when covered with thimbleberry syrup were irresistible.

## HISTORY

The Oregon grape (*Berberis aquifolium*) has some rather unique and interesting qualities which make it a worthy survival food.

If you're not familiar with the name Oregon grape you may recognize the plant by other common names like holly grape, barberry, mahonia, or mountain grape. It is the state flower of Oregon and grows most abundantly in the mountain ranges of the Pacific Coast area but can also be found throughout the Northwest and some related species grow down the Rocky Mountain chain to New Mexico.

The holly-like leaves are dark green in color and the fragrant yellow flowers are followed by clusters of red berries turning to dark purple when ripe in the fall. The plant is a low shrub, often used in ornamental hedges and is spread by means of an extensive pipeline of root stems beneath the ground.

The Oregon grape is a reputed medicine chest with a long and tested list of uses to its credit. The Indians of New Mexico called the holly-leaf grape the "Sangre de Cristo" or Blood of Christ because of its blood red juice which they believed would cure many ills.

According to the well known herbalist, Rodale, berberis was listed in the American pharmacopoeias until 1950. The bark of the root was the source of the official drug berberis and was administered as a bitter tonic as well as a treatment for liver and digestive disorders.

Some Indian tribes used a decoction of the root and bark for treating ulcers, heartburn and rheumatism and as a wash for cuts and bruises. The Navajos still use the leaves and branches as a treatment for pneumonia.

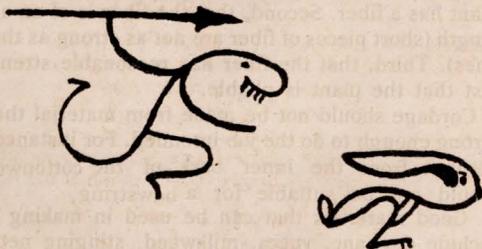
The yellow bark of the Oregon grape was long used by the Indians and finally accepted by the white community in the early 1800's as a medicine for yellow jaundice. An



**Whole wheat bread, leavened with oregon  
grape yeast and baked in a stone oven.**

interesting side note comes from a centuries old association of ideas called the 'doctrine of signatures' which taught that a yellow plant must be used in treating a yellow sickness.

Virginia Skully in her book "American Indian Herbs" listed a couple of rather questionable uses including chewing the leaves as an acne treatment and drinking a decoction of the leaves before the morning and evening meal to bring on menstruation. Often times such "cures" were a mixture of many herbs which have since become obscure and thus the real value lost to the modern herbalist.



# WILDERNESS CORDAGE

by Dick Jamison

Remember the year of the Indianapolis 500 race when Parnelli Jones was the sure winner, only to lose from a breakdown caused by a \$3.00 part.

Insignificant as it may seem, every small item is important in a survival situation. Either your bowstring works or it doesn't, either your trap springs or it doesn't. Almost—a fatal word in survival.

Similarly can you imagine yourself dangling from a ledge by a piece of rope, your life dependant upon the strength of the line to which you are tied? Would you trust your life to hand-made cordage twined from so common a plant as milkweed or yucca?

Many primitive people of the past as well as today trust their very lives to rope made of plant fibers. Bridges are built over deep gorges and rapid rivers using the materials that nature offers. The Indian people who once populated the Southwestern United States often used such rope in ascending their precarious dwellings as well as to assist them in many chores related to their everyday living.

Under survival conditions there will be a time when you need some type of string or heavy cord.

**The art of making rope or cordage from plants, leather, sinew or other fibrous material is called cording. It is one of mans earliest primitive skills. Primitive people did not have the many conveniences we have today and necessity is always the best teacher. Primitive use of plant fiber is wide and includes not only cordage but blankets, sandals, baskets, clothing, bridles, nets for fishing and snares for capturing game. Because of the world we live in we have lost many of these skills and have lost a part of our education in the process.**

I have noticed that the making of cordage from natural materials is overlooked in most survival books. Many authors are not familiar with or knowledgeable in primitive arts so therefore are not aware of the uses of the fibrous plants. This is unfortunate because the art of making cordage is not difficult to learn but like any skill it takes time and patience to do it well. I consider anyone a pro who has made 25 feet or more. If you balk at 25 feet consider the fact that netting made by primitive people has been found to contain miles of cordage.

When looking for cordage plants, there are several things that should be considered. First, make sure the plant has a fiber. Second, that the fiber is of an adequate length (short pieces of fiber are not as strong as the longer ones). Third, that the fiber has reasonable strength and last that the plant is pliable.

Cordage should not be made from material that is not strong enough to do the job intended. For instance, useful cordage from the inner bark of the cottonwood tree would not be suitable for a bowstring.

Good materials that can be used in making cordage include dogbane, yucca, milkweed, stinging nettle, and sage as well as the inner bark of trees such as the



Breaking out the fiber



Loosening the fiber

cottonwood, cedar and juniper. This inner bark is often abundant in large quantities in many areas and provides good material for weaving blankets, clothing and for bedding.

It is important to know the useful plants in all stages of growth so that you can recognize them readily when needed and when in their dry state.

Many plants fall into four categories, they are 1) edible 2) poisonous 3) medicinal and 4) used for plant construction. A large percentage of them fall into two or more categories. For instance, dogbane is a poisonous plant but is excellent in making cordage. The same is true of milkweed, it is considered an edible plant and can also be made into cordage. The yucca plant fits into three of the four categories...the fruit and flowers are edible, the dry stalks can be used as fire board and drill for fire by friction, the roots are medicinal and make an excellent soap substitute, the spines can be used as needle and thread for quick repair jobs and the fibers make a strong cordage.

Nettle can be found in moist areas in many parts of the country. It can be collected green but should then be dried to extract the fiber more easily and to eliminate shrinking of the completed cordage. Be very careful when collecting nettle as the sting can be quite painful.

My favorite fiber plant is the dogbane. As I mentioned it is considered poisonous but also contains one of the strongest fibers of the wild plants. Its reddish hue makes it easy to recognize during the fall and winter months when it is dry and ready to collect.

Yucca is unique in that it can be used while still green when necessary thus eliminating the time consuming pounding and extracting process. The fiber of the yucca is found in the core of the stem opposed to the outer layer as with dogbane and milkweed. For a strong fine textured cordage it should be soaked for several days to loosen the fiber then dried and gently pounded into silky threads. Several Indian tribes used this very fine fiber for weaving lovely cloth and baskets.

Milkweed also yields strong material for cordage and its availability in areas where dogbane and the other plants are lacking makes it even more valuable. The milky juice within the plant makes it necessary to thoroughly dry it before beginning to extract the fiber. The dry seed pods which remain on the stem in the fall and winter make it easy to recognize in this stage.

The plants mentioned here grow in many geographical areas of the United States but you may wish to test other species of plants native to your part of the country to find out if they are suitable for making cordage. Remember, your main concern is with strength, pliability and the length of the fiber.

Most plant fiber is located on the outer part of the plant stem and in order to extract it the inner pith must be separated from the fiber. While laying the stem on your leg or some smooth surface use a gentle pounding motion with a rounded stick or smooth mallet. This will crack the stem without breaking the length of the fiber. At this point you can rub and roll the pulp from the remaining fiber by hand, again being careful not to break the length of the fibers. The result of this process is soft flax-like threads which will be quite pliable.

Now that your material has been extracted from the plant you are ready to begin the steps in making the cordage.

continued next page

Wilderness is the great equalizer.

It's here to be understood, not conquered. At once a tyrant and a pawn, its strength is matched only by its incredible fragility.

Set yourself up for nature's wrath.

Without any technological advantages. On a one to one basis.

Wilderness survival is learning and being able to apply the primitive arts.

**OUTDOOR SURVIVAL SKILLS**, Larry Dean Olsen. A book to teach you what you need to know about living.

Send me .....copies of personally autographed edition of **OUTDOOR SURVIVAL SKILLS** at \$4.95 per copy. I have enclosed a check or money order for the total.....

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There are several methods of twisting the fiber but the basic principle is preparing it by rolling the piece down your leg with your open palm until it is rounded and reasonably uniform in size. Now, taking the resulting string, bend it about  $\frac{1}{3}$  IN HALF (in other words, leave one end  $\frac{1}{3}$  longer than the other). The small loop in the bend will be your starting point and should be held between the left thumb and forefinger if you are righthanded. You will have two loose ends hanging from the loop, taking the top piece between the thumb and forefingers on the left hand to hold the twist secure. Now fold the strand you have just twisted toward you or counter-clockwise and repeat the procedure with the opposite strand, the fingers on the left hand moving toward each new twist to hold it secure.

When you reach approximately 3 inches from the end of your shortest strand, lay a new piece along the side overlapping it to give a strong splice and roll the two together. Continue the twisting and folding until the desired length is reached. Your cordage will not unravel due to the clockwise counter-clockwise twist which actually tightens itself.

The strength of your cord will depend upon the thickness of your strand. Two or three strands of cordage may be twisted together in this manner for more strength as needed. Be sure that your splices are not at the same point or opposite in your cordage because this will weaken the strand, also try to make uniform strands to insure against weak spots.

Sinew or animal tendon is the strongest natural material available and should be used in making such items as bowstrings, weapons and tools. Dried sinew must be prepared by pounding it until it is whitened and the fiber is separated. Be careful not to pound so vigorously that you break or cut the strands of fiber. After the sinew has been folded and twisted by the methods described for plant fiber, it is finished by stretching it between two points and rubbing saliva or other liquid into it until all the rough spots are smoothed out. It must then be allowed to dry in this position.

I have always found it rewarding to seek out the various plants and explore their various uses. Even my small children ages 4 and 8 enjoy working with the plants and are quite apt at making cordage. It is surprising how quickly young children learn to identify the different species and their uses, it would be wonderful if we could instill this knowledge and appreciation at an early age so they could add upon it throughout their lives.

There are two books with chapters on the subject of fiber cordage, "Outdoor Survival Skills" by Larry Dean Olsen, and "Bushcraft" by Richard Graves.

**The two pieces of twisted fibre wind easily together as the tension is lessened.**



Twisting fiber between palm and thigh



The pitch of most evergreen trees is useful in a survival situation for providing fire starter, glue, sealer, waterproofing, filler material and even smear-on bandages.

To harvest the pitch find a scarred or damaged pine tree where the pitch has oozed out to form balls. Collect only the hardened lumps of pitch. A yellow color to the lump is a good sign that the pitch is free of impurities. A small handful will make plenty of pitchsticks.

When the pitch is collected, cut a short stick about 12 inches long and at least 2 inches thick. Cut a flat surface at one end forming a crude heating spatula. Cut several small dry twigs about the size of matchsticks, but longer and lay them aside. Then build a small fire for the heating process. Place the pitch on the heating spatula and hold it near the fire until the pitch melts and begins to run. Then quickly, while the pitch is running, roll one of the small twigs across the top of the lump of pitch, gathering the melted portions. This is done by twirling the twig between your fingers. Collect an even amount of pitch along the twig, leaving a small handhold at one end. When a layer of pitch clings to the twig, quickly dip it in cold water. This cools the pitch making it hard. Return the pitchstick to the spatula and roll another layer of hot pitch over the hardened layer, dip in cold water and then repeat the process until a thick layer of pitch surrounds the stick. It should look something like a miniature popcicle. The finished piece is then rolled between palms of the hand to mold and shape it.

Pitchsticks should be wrapped and stored separately as they tend to stick together in warm weather.

Two other methods of making pitchsticks include boiling the pitch in a little water and then skimming off the hot pitch with your twig and molding them with your hands after slight cooling. The second method is to simply place a lump of pitch on a flat sloping rock that has been heated by fire, and collect the hot pitch as it runs down the rock.

Adding a small amount of powdered charcoal from the fire to the melted pitch will make it stronger when it hardens. Charcoal is important if the pitch is to be used as a sealer for basket waterbottles, or for hafting stone knives.

With these pitchsticks tucked away in your possible bag, you may feel a little more confident that your wilderness survival efficiency has broadened. With them you may start your fires by lighting one end of a pitchstick and placing it carefully under a small tepee fire. The pitch burns like rubber and will dry out damp twigs to get the fire going.

By heating the surface of a wooden shaft and rubbing it on a pitchstick, you may coat the shaft with a thin layer of pitch which will help keep sinew wrapping and lashed surfaces from slipping. This is most important in the construction of arrows, bows, fish spears, deadfalls, and any other compound tool where parts are to be bound together.

Pitchsticks may be used to patch holes in water jugs, canteens and even rubber rafts in an emergency.

Warm clean pitch may be smeared over a cut as a smear-on bandage. It is a disinfectant and protects the wound from outside contaminants.

By chewing pitch as a gum, the teeth are cleaned, especially if a few bits of charcoal are added.

Make a pitchstick and add this welcome addition to your possible bag.



by Thomas Dumis



# EARLY SPRING EDIBLES

By Linda Jamison

When Euell Gibbons came on the scene, hiking the country trails, chomping stalks of wild asparagus and proclaiming the virtues of "wild hickory nuts" there became a revival of wild food enthusiasm. The writings of Gibbons resound a simple enjoyment and appreciation of nature derived from learning about and utilizing wild plant life. His philosophy of "reaping what you did not sow" makes pleasant and informative reading.

For whatever individual reasons we may have, many of us are adopting this same philosophy and saving money as well. Wild plants are not merely for famine or survival conditions as many have thought of them, but there are many everyday benefits that can and should be derived from gathering, preserving and eating these herbs.

Most gardeners plant peas, beans, and other garden vegetables then meticulously weed out foods every bit as nutritionally valuable as those that are planted. Gardens must be weeded, but if you keep a plastic bag at your side the tender young "weeds" can be collected and used rather than thrown into the compost. An alert gardener could conceivably feed his family on the discarded weeds of his neighbors.

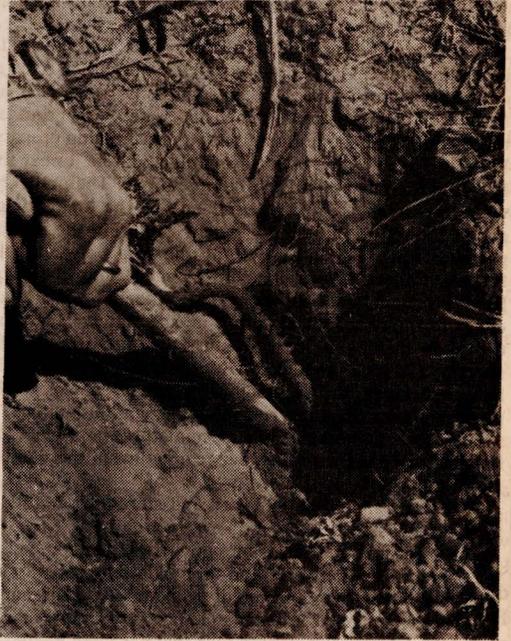
Food is food, vegetables are vegetables whether wild or cultivated. Remember that our cultivated foods were, at one time wild plants. The old adage of "you get what you pay for" isn't true in this instance. For example, watercress contains three times as much vitamin E as lettuce and almost three times as much calcium as spinach. Dandelion offers six times the quantity of vitamin A and more than twice that of the calcium, phosphorus and iron contained in garden lettuce.

A working knowledge of wild plants can provide free food and supplement a basic diet with valuable vitamins and minerals. Dr. Harris of the Massachusetts Institute of Technology told the American Academy of Arts and Scientists that "world hunger, which breeds revolution and unrest could be conquered if unusual foods, some of them considered weeds, were more appreciated and utilized in the undeveloped countries." Telling of his analysis of more than 1500 unusual food plants in Mexico, Central America and China, Dr. Harris explained, "some people in the Mexican desert are well fed because they eat the native plants we would spurn, but which experience has taught them can provide the essentials of good diet as well as meat, milk and eggs which we consider necessary."

The following passage from the factual biography of Dr. George Washington Carver offers the same point of view.

Dr. Carver was approached by a tramp one day who asked him for a dime for something to eat. As he watched the tramp with the dime head for the nearest store, he shook his head sadly, "It's pitiful, pitiful," he said to his companion, "between here and that store there's enough food to feed a town." He pointed to the weeds growing beside the road and to the wild plums overhead, "and a balanced diet, too."

Preserving wild foods is important and simple. Greens and fruits may be canned or frozen the same as the



Digging Biscuit Root



Biscuit Root

cultivated foods. Frozen foods contain more vitamins and minerals than the canned products because of the long process of heating necessary in canning. Roots must be peeled or carefully washed, then packed tightly into sterilized jars in the same manner as carrots or beets. Wild berries and fruits can be easily dried, canned or frozen for winter succulence.

It is conceivable that wild foods will not delight your family at first and it would be advisable to add them to your diet a few at a time or mix them with other more familiar foods. A little amaranth or lambsquarter fresh in a salad with spinach will seldom be noticed and besides adding more nutrition to your other foods, is an economic extender. Herb-eaters soon learn the economic values of collecting edible leaves, roots, berries, seeds and nuts as well as other herbs that can be used for coffee substitutes and teas or medicinally.

Because of our taste preference for tender, mild, crisp vegetables the obvious time to collect many of the wild edibles is in the spring. The plants to be discussed in this article will center on those that are available at this time of year.

Care must be taken when collecting the young plants that have no flower, as identification is often difficult and a careless judgement could prove fatal. Let me give you a couple of examples. In the young or sprout stages it is almost impossible to differentiate between the edible milkweed and the poisonous dogbane, a relative of the well-known oleander which grows in the south and western United States. The strength of poison attributed to the dogbane family is quite dangerous. According to Dr. John Kingsbury, Professor of Botany at New York State College of Agriculture, a branch of dogbane or oleander used to skewer meat at a picnic could prove fatal by the poison being transmitted into the meat.

The similarity to the young milkweed is amazing. The leaf structure and placement, coloration size and milky sap is almost identical. Even a trained eye would pause before making a judgement. The main difference seems to be the texture of the leaf, the milkweed having a fuzzy appearance while the dogbane is slightly smoother. The two grow in much the same geographical area and are often found within a few feet of one another.

The second example that should be brought to your attention is the similarity between the wild onion, edible camas and the poisonous death camas. The alkaloids in death camas have caused much loss of life to both man and livestock from the western plains to the Pacific Ocean. The leaves of the death camas are long and narrow arising from the central bulb identical to that of the onion. Only the tell-tale smell of the onion is absent. This is not always a foolproof means of identification since anyone who has been picking wild onion will retain the odor on their hands for several hours. The edible camas bulb is also very similar to that of the death camas bulb and the onion. The secret to identification of the death camas before flowering is through careful study of the leaf structure which is flat and v-creased along its length and is solid opposed to the hollow leaf of the onion. The danger of mistaken identity is always greatest before flowering but occasionally one will gather the flowering death camas along with onion or edible camas with possible fatal results.

This warning is not meant to discourage anyone from enjoying the glorious harvest available in the wilds, but to induce a proper respect and the need for knowledge in



Death Camas



The v-shaped leaf of the Death Camas distinguishes it from the edible camas.

identifying the edibles.

Because so many of the spring plants are favorites it is difficult to choose what to include here as early spring edibles. Here are 10 plants which rank high on the list.

**Amaranth** (*amaranthus*), more commonly called red root, ranges coast to coast and is found in most cultivated fields and along roadsides. Its name is derived from the bright red root topped by a stout hairy stem that often grows to 5 feet in height in good soils. The leaves are rough and long with toothed edges. The seeds are black, shiny and very small.

This plant was used in abundance by the Indians and early settlers. When young the greens are boiled or steamed to make an excellent mild pot herb. Some seasoning or bouillon could be added to enhance the flavor. The seeds are also valuable as an extender for other flours and produces a buckwheat effect. The easiest harvesting method is to collect the seeds which are abundant in each cluster by picking the plant tops and putting them in a paper bag. The bag should be hung in a cool dark place for several days or until the plant is completely dry. Then a good shaking will release the seeds and winnow out the chafe. For proper digestion the seeds must be ground before eating and better flavor is achieved by roasting them before grinding.

Amaranth has been known as a medicinal plant for centuries and was used by some in the treatment of diarrhea or for mouth and throat irritations. However, its curative properties are so mild that the medicinal use of amaranth might give in to some of the more potent wild herbs.

**Asparagus** (*asparagus officinalis*) at 68 cents a can is not nearly so inviting as the free for the picking victuals found in many fields, borders, roadsides, railroad tracks and irrigation ditches where it has been scattered by birds.

The wild asparagus plant is exactly the same as the cultivated species leading one to believe that it is already at its delicious best and can't be improved upon.

The most reliable method of locating the young shoots is to look for last years straw-colored dead stalks and the new growth will be found pushing up its tender head directly below.

Rule number one after you have located a good asparagus patch is to keep it to yourself. Pick enough to share with friends and neighbors but never "pick and tell". You will be able to make several cuttings each season since the perennial roots will grow a new shoot after it has been cut.

The most common method of preparation for asparagus spears is boiling or steaming for approximately 20 minutes and serving with butter. Cream of asparagus soup is also delectable and is an excellent way to use the spears that are tough for serving otherwise. Asparagus is delicious cooked with any mushroom or cheese topping and is excellent served on toast.

The red berries which appear in the early fall are also edible in small quantities but you must be on your toes to beat the birds to one of their favorite meals.

Asparagus has, in times past, been used as a diuretic and mild laxative.

**Biscuit Root** (*cymopterus*) is a member of the carrot family and has a large bulb-like or in some species a slender tap root, which is edible. The biscuit root is often found in dry areas thus the root grows quite deep as it reaches far into the soil for moisture. Its leaf is lacy and



Cattail



Peeling Biscuit Root



**Digging Biscuit Root**

resembles that of a carrot or queen anne's lace and its flower ranges from a pale pink or yellow to white with umbrella type structure.

Biscuit root is known as the famous "bread of cows" or kouse, which sustained the Lewis and Clark expedition. They traded horses to the Shoshone Indians in exchange for biscuit root that had been roasted, ground then baked into huge cakes that were carried with them and became their mainstay during much of their travels.

Although biscuit root may be eaten raw it is more tasty when cooked or added to stews and soups. The roots may be baked like potatoes in the coals of a fire than sliced and dried for a nutritious trail food.

The roots are best in the spring which violates the general rule of thumb for collecting root foods.

The plant has been used as an insect repellent. A strong tea is brewed from old roots and sprinkled around camp or rubbed on the skin.

**Burdock** (arctium) also called wild Gobo is easily mistaken for rhubarb and is grown domestically in some countries as is rhubarb. In the United States it is so abundant in some areas that it could be treated as a crop and actually cultivated.

The stalks of burdock often grow to a height of 3 feet or more with large egg shaped leaves. It has tubular purple



**Eating biscuit root raw**

flowers followed by the small burr from which its name is derived.

The very young roots from the first year plants are peeled of their thick rind, sliced thin and boiled for approximately 30 minutes. The water is then poured off and they are cooked for a few more minutes with a small amount of fresh water and served with butter and salt.

The leaves of burdock may be eaten raw or cooked in the early spring but the best results are achieved when par boiled (boiled once then drained and boiled in fresh water). Even the pith of the large stalks is tasty when peeled and prepared in the same manner as the root.

Unless found growing in moist soil, a digging stick must be used because the roots grow quite deep and cannot be pulled.

The secret to a full enjoyment of burdock is gathering it in the proper stages of growth. When eaten late in the season its flavor borders on being obnoxious.

Burdock is reputed to give strength, endurance and vitality and has been part of the wedding ceremony in some countries for centuries. Medicinally it has been acclaimed in the writings of Culpepper to Gray as one of nature's finest blood purifiers.

**Cattail** (typha) according to scientists, has been growing on the planet earth for about 15 million years. The yield from a cattail marsh is amazing, research has determined that rhizomes, or roots of the plant can be harvested at a rate of 140 tons per acre, more than 10 times the average yield for potatoes and far ahead of the average yield of wheat, and oats.

It's shameful that such an abundant and valuable crop is not utilized to its fullest extent, especially when we consider that the cattail parallels rice and corn in its nutritional value.

Another advantage of the cattail is its extensive season. It can be utilized for food from early spring when the tender bulbs and shoots first appear, throughout the summer months when the spikes and pollen are more prevalent and into winter when the starchy roots are at their best. Because we are primarily interested in spring plants, only the uses of cattail shoots, spikes and pollen will be discussed at this time.

When collecting the cattail shoots, the inner leaves should be grasped and pulled gently to break them from the bulb and slip them from the outer leaves. The young shoots resemble leeks in appearance and are enjoyed by the Russians from which they get their nickname of 'cossack asparagus'. These tender shoots can be eaten raw but are more easily digested when cooked due to the cellular structure. Their taste is very mild, not what you might expect from a marsh plant. It can be mixed with other plants to tone down more distinct flavors.

The young spike or flower head is best before it breaks out of its sheath and before the pollen appears. These spikes are peeled from the stalk or cooked like corn on the cob right on the stem. Add a little salt and butter and you will have a dish every bit as nutritious and tasty as any cultivated vegetable.

Cattail pollen, as any other pollen, is high in protein. The ease in collecting large quantities of this pollen makes it especially valuable for everyday use as well as to store for the future. The best method is to simply bend the stem over and strip the pollen off between the fingers into a plastic or paper bag. Harrington suggests in his book "Western Edible Wild Plants," that if you plan to store

the pollen it be heated first in a moderate oven, 350 degrees until thoroughly dry.

Cattail pollen can be used in most any recipe by mixing it  $\frac{1}{2}$  and  $\frac{1}{2}$  with whole wheat flour. The taste is pleasant and makes a nutritional and thrifty extender.

**Dandelion** (taraxacum) is probably the most common and widespread "weed" in the world. It grows equally well at varied elevations and small parachutes carry the seeds great distances to populate both welcome and unwelcome areas. Because they are unwelcome to some and are sprayed with chemicals that could be dangerous if taken internally, it is best to avoid using dandelions from lawns.

When substituted for or added to other vegetables, dandelion greatly improves the food value. For example, dandelion has 4 times the protein, 3 times the vitamin C, 7 times the calcium, 4 times the iron and over 10 times the vitamin A of garden lettuce.

Dandelion flowers and flower buds are tasty either raw or cooked. The buds when collected before the flower opens, can be dipped in a batter and cooked like fried okra. The flowers added to salad raw or cooked with other vegetables are both tasty and colorful.

The roots of dandelion can be made into a coffee substitute, however, its flavor is slightly more bitter. Peel the roots and cut them into small pieces, then roast until brown (the roasting process will determine the flavor) and grind. The dandelion coffee is then ready to perk just like coffee or mix with coffee to economize.

Dandelion is one of nature's more effective diuretics and cleanser of the liver and gall bladder according to La Dean Griffin in her book "No Side Effects."

This herb also has been used by persons who need calcium, as it is quite high in this ingredient, as well as other vitamins and minerals.

**Dock** (rumex) or sorrel is often recognized by its 3 winged, rust colored seeds and stalks which are known as Indian tobacco by some. There are approximately 25 species of dock growing in waste places and along roadsides of the Western United States, most of which are edible and quite tasty. Dock grows from a perennial root with a leaf that resembles that of a dandelion leaf, but is more course with curling edges. The taste of dock is more sour than bitter which makes it enjoyable added to salads raw when young and tender.

The plant is very high in vitamin A and contains a reasonable amount of protein.

The seeds of dock were utilized by the Indians but are so small and tedious to separate from the chafe that this process might become discouraging.

The leaves are often the first green sign of spring and the last green growing in the fall making them readily available for salads or to cook as a potherb. A change in the cooking water is advisable to tone down the sour flavor. A bouillon cube added to the cooking water will add a touch of its own, and gives the vegetable a slight boost.

Rumex has been listed in the U.S. Pharmacopoeia as having roots useful in making a tonic astringent, laxative and alternative and to treat itching externally. The Blackfoot and Navajo Indians mashed the roots to a pulp and applied it to human sores as well as to their horses for saddle sores.

**Lambsquarters** (chenopodium) is sometimes referred to as pigweed, however this may give one a false impression of the tastiest of wild greens. The plant is found virtually covering the entire United States and may also be

recognized as goosefoot, wild spinach and other aliases. However, "pigweed by any other name...."

Euell Gibbons mentions that some people dislike eating the plant because of its name which makes them wonder whether it is only for pigs. He also brought out the point that pigs will eat pies, cakes, strawberry shortcakes or caviar if available as well as pigweed.

Pigweed or lambsquarters are easy to identify by the dull green arrow shaped leaves which are coated on the underside by a white powdery substance. The seed clusters are brownish grey and quite abundant. In good soil the plants may grow to 4 feet, in fact the taller plants seem to be more mild than those grown in dry areas in less fertile soil.

To most wild plant enthusiasts lambsquarters are one of nature's best, whether eaten raw or cooked. The stem is picked where it snaps off easily, as with asparagus. The whole plant (excluding the roots) can then be boiled until tender, about 25 to 30 minutes and served as any green leaf vegetable. A little vinegar or lemon juice adds tang to an otherwise mild dish. When eaten raw the leaves are stripped from the stem and tossed in a salad with herb vinegar and garlic for a great tasting treat.

When picking lambsquarter be sure to gather a little extra as it cooks down quite a bit and you are certain to want second helpings.

The seeds of the plant have been used extensively by the Indians in making gruel or ground into a meal. The best method of preparing the seeds is to parch or roast them before grinding. They can then be blended into any other flour and used in whole wheat recipes.

As listed in several herbals, the ground seeds of chenopodium are said to be an anthelmintic (to dispel worms) followed by a cathartic (laxative).

The broad leaf Milkweed (asclepias) is one of nature's more productive succulents. At various stages of growth it provides food from spring until fall.

A special cooking or taming process is important to eliminate the extreme bitter flavor associated with the entire plant.

When properly prepared young milkweed shoots (6 inches or less) are quite palatable. Drop the young shoots into rapidly boiling water and cook at a full boil for approximately 3 minutes. Drain and repeat this routine 3 times always using fresh **boiling** water. After the last treatment add salt and butter and simmer for about 10-12 minutes more with a slight amount of water, then serve creamed or in any manner that asparagus might be served.

The top leaves of the young plant are also tender but must likewise be put through the "taming" process as suggested for the shoots. They may also require slightly longer cooking than the shoots.

Milkweed flower buds (before they open) are preferred by many to other parts of the plant. Their "wooly" appearance may seem unappetizing but this is quickly transformed to a bright green when added to boiling water. After the "taming" routine the buds are dished up with a cheese sauce or garnished with herbed bread crumbs.

Several Indian tribes actually cultivated the milkweed plant by cutting and transplanting the roots. They used its several edible parts for food as well as medicine.

The plant is quite high in ascorbic acid and the seeds contain a valuable oil similar in quality to soybean oil.

Milkweed root has, in times past, been used as a

stomachic and diuretic.

**IMPORTANT**-Remember the warning associated with the identification of milkweed. Be absolutely sure you are picking milkweed shoots and not poisonous dogbane.

Wild **Onion** (allium) is one of the more abundant wild foods and some species can be found in every state of the nation and even in Canada and Mexico. According to the Air Force training manual all are edible although size and flavor will vary with each geographical area. Approximately 40 different species have been reported in the West alone.

The onion grows from a basal bulb with either flat or rounded leaves and umbel shaped flowers which vary in color from white to purple.

This plant could and should be considered as a food staple rather than a flavoring spice or additive to salads, etc. When using the bulbs as a vegetable they should be parboiled, then cooked in a small amount of water with salt and butter added.

You will be able to find many recipes in ordinary cookbooks for the cultivated onion which will also apply when preparing the wild onion.

If you have had the opportunity to eat the wild onion you know that it is far more pungent than the domestic varieties. This seems to be characteristic of most wild plants in comparison to their cultivated relatives.

Often entire hillsides will be covered with wild onions or garlic, more than enough for a summer and winter supply.

The onion holds a place in history as do many other "wild edibles". It has proved a mainstay in the diet of several early explorers and was used extensively by the Indians both as food and medicine.

The flowers are delicious and the stems and leaves should not be wasted. An outstanding preparation can be made from the flowers by dipping them in a batter and deep frying them for 2 to 3 minutes. This makes an excellent snack food.

The seeds of the mature plant can be collected for seasoning and ground in a regular pepper mill.

Inclusion of onion or garlic in the diet is said to be an excellent and proven preventative. Dr. Vogel in "The Nature Doctor" claims that an onion or garlic poultice will relieve a toothache. It was widely used by settlers and primitive peoples to break a fever quickly. Beatrice Hunter, a noted herbalist, has credited the onion with antibiotic qualities.

Rubbed on the skin the juice of the onion or garlic will repel insects,...and anyone else in the immediate area.

**IMPORTANT**-Remember the warning associated with the identification of this plant. Be absolutely sure you are picking onion and not death camas.

This list of spring delectables is far from complete. The main objective has been to create sufficient interest in wild foods so that you will be encouraged to do more investigation on your own, gain a sure knowledge of their identification for safety, and then make use of these valuable early spring edibles.



## food production, people and the future

by Sylvan H. Wittwer

Solutions to the world food problem seem more common today than the problems themselves. The issue is not one of agricultural production capability. There was never a greater opportunity for food abundance. The exploitation of that opportunity, however, was never more vulnerable to the uncertain responses of human political institutions. There must be the political will to produce food. The USA and the world are becoming increasingly susceptible to this constraint.<sup>1</sup>

Assuring our food supply is also more than production. It involves post-harvest handling, processing, storage, and consumer use and acceptance. There is enough food now produced to feed the world's hungry. Today we have more food per capita than twenty years ago. That people are malnourished or starving is a question of food distribution, resources, and economics, not agricultural limits. The problem is delivery. It's putting the food where the people are, and providing an income so they can buy it.

Currently, hysterical campaigns are being waged against population growth. An expanding population is declared the greatest threat to mankind.<sup>2</sup> Americans have been persuading themselves, but not the world, that man is overrunning the earth. Little can be done in the immediate future to reduce population growth, short of catastrophic events such as earthquakes, famine, pestilence or war. These are either uncontrollable or undesirable alternatives.

I am optimistic about man's capability of feeding himself, now and in the foreseeable future. How many of the 1.5 billion people at the beginning of this century would have believed the earth could have now absorbed 4 billion?

We often speak and write as if malnutrition, famine, and starvation are new afflictions besetting the human race. They've always been with us, and more acutely so in the past than at present. A worldwide communications network of visuals and words, now brings home to us daily the reality and at times the unreality of it all.

I totally reject the concept of "triage" or the "lifeboat ethic."<sup>3</sup> This philosophy states that we cannot possibly save all mankind from starvation, and we have to decide now who is expendable. It is morally unacceptable, politically unrealistic, economically unsound, ethically unthinkable, and realistically unnecessary if one gives any recognition to human creativity and the management of resources.<sup>4</sup>

The immediate solution lies in all-out food production, improved nutrition, and education. The victory has to be an agricultural one. It will take a Herculean effort. "We will have to find in the next 25 years, food for as many people again as we have been able to produce in the whole history of man till now."<sup>5</sup>

There are four good reasons for increased emphasis on food production in the United States. First, the humanitarian-assist starving people overseas. This has become a tradition and legacy of America. Secondly, it will help reduce current worldwide unrest, anxiety, and tensions. Thirdly, it will help keep food prices reasonable for everyone. Finally, it is good business to maintain a favorable balance of payments in international trade. During 1975, the USA produced 92 percent of the world's surplus food and had an agricultural export return of over \$23 billion. The prospects are that food dependence on North America will continue.

A paper presented at a symposium on "The Changing Role of Agriculture" sponsored by Brigham Young University, Centennial Agricultural Week, March 19 - April 2, 1976. This paper is an extension, updating, and further amplification of three previous documents by the author: "Maximum Production Capacity of Food Crops," *BioScience* 24 (1974): 216-223; "Food Production Technology and the Resource Base," *Science* 188 (1975): 579-84; and "Priorities and Needed Outputs in Food Production," *Food Technology*, September 1975, pp. 28-32. Sylvan H. Wittwer is director of the Michigan State University Agricultural Experiment Station, assistant dean of the College of Agriculture and Natural Resources and professor of horticulture at Michigan State University, and chairman of the Board on Agriculture and Renewable Resources, Commission on Natural Resources, National Research Council, National Academy of Sciences.

## FOOD PRODUCING TECHNOLOGIES-AT HOME AND ABROAD

race. 13

### STABILITY OF PRODUCTION

U.S. research and technology have developed an agriculture which is capital-management-and-energy intensive. There is emphasis on laborsaving technology. This may not be what the rest of the world wants. It may not continue to be the best for us. Unemployment, inflation, and food needs are global issues. Partial resolution of these problems may come from food-producing technologies that are labor intensive with production maintained at high levels, and with minimal input of capital, management, and the nonrenewable resources of land, water and energy. Such technologies must also be nonpolitical.

Thus far we have given little attention to research and development in these areas, but they do exist. A good example is the production of hybrid cotton in India where tens of thousands of workers are required to hand pollinate the flowers, but yields are doubled.<sup>7</sup> Ultralow-volume knapsack sprayers for pest control in agriculturally developing countries; the production of short statured wheat varieties in Pakistan and Punjab of India; multiple cropping systems in the tropics; and reduced tillage and surface interseeding of crops in temperate zones are other accomplishments.

A prime example of a food producing system that is labor intensive, high producing and with a minimum of resource, capital and management input is the home food garden.<sup>8</sup> Vegetable and fruit crops are seldom included in world food statistics. Yet they can, and do, contribute significantly to food supplies. The science and art of food production in home gardens should be exploited. Production is at the site of use. Wastes and by-products can be utilized as fertilizer. Energy expenditures from fossil fuels are minimized. Marketing, packaging, and transport problems are eliminated. High production and top quality are possible. Home gardening can be the most intensive food production system on earth. Vegetables (beans, peas, potatoes, cucurbits, root crops, tomatoes, onions, crucifers, and sweet corn) are principle sources of calories, proteins, vitamins, and minerals for hundreds of millions of people.

### FOOD SOURCES

A consideration of the world food problem must include thought as to what food is to be provided for whom. If the world's population is to be fed, what will it be fed with? It will likely be that which people are familiar with.

When it comes to human nutrition there are issues of flavor, appearance, and acceptability. Someone is going to have to eat what is produced. Dietary habits of people are not changed easily or quickly. The primary effort in food production for the immediate future must be directed toward conventional food crops, not the unconventional.<sup>9</sup> Conventional food and feed crops serve as the primary food sources for both people and the livestock products consumed by man.<sup>10</sup> Chief among the food crops are rice, wheat, maize, soybeans, millet, barley, oats, rye, sorghum, field beans, chick peas, pigeon peas, peanuts, cassava, potatoes, sweet potatoes, sugar beets, sugarcane, coconuts and bananas. Fruits and vegetables, processed and fresh, add personal enrichment and joy in eating and provide essential dietary nutrients. Hay and pastures provide most of the feed units for cattle and sheep.<sup>11</sup>

There is now the strong suggestion that the world's food problem is not one of protein deficiency but caloric adequacy. If sufficient calories are provided through conventional food crops, and the biological values of the proteins of these same crops are genetically upgraded, there should be no protein problem. Eighty percent of the people in India are vegetarians-they don't eat meat. The dietary merits of a vegetarian diet based on new improved cereal grains alone account for 60 percent of the calories and 50 percent of the protein now consumed by the human

Variabilities in the yields of food crops and livestock production from year to year and area to area are principle causes of food shortages and surpluses. Weather is the most determinant factor in food crop productivity. Production stability at high levels can be achieved only as environmental stresses are minimized. Season to season weather variations are of much greater significance than any identifiable long-term climatic changes.

The year 1975 was a classic example. India, with favorable climate and rainfall produced an all-time record crop of 115 million tons of food grains. The USSR by contrast, had a dismal failure with an estimated 135 million tons of grain compared with a projected hope of 210. Not since the days of Khrushchev have the Soviets had such an agricultural disaster. Meanwhile, the USA produced a record corn and wheat crop in 1975. A drought in the U.S. corn belt during 1974 resulted in production that was more than 20 percent off in yields per acre of corn, wheat, soybeans, and sorghum.

Decreased vulnerability of crops to weather uncertainties must be sought. Stability of food production at high levels should be a global research imperative. It could be improved by nitrogen self-sufficiency; identification of aspects of photosynthesis which limit CO<sub>2</sub> input; innovative water management; an understanding of the mechanisms of senescence; improved pest management systems; and for both crops and livestock the ability to predict extreme weather events at crucial times.

Little research has been done to optimize the use of limited water resources in crop production. Over one half billion people live in the semiarid tropics. These are areas frequented by violent and unpredictable storms. The goals are the development of improved water management practices, and crop varieties less vulnerable to the weather. An international agricultural research center has been established for this purpose.<sup>14</sup>

There are current anxieties as to the price of food and its adequacy. The impact of weather, and a rising population of increasing affluency coupled by a depletion of world stocks of grain have precipitated an instability, volatility, unpredictability, in the price of corn, wheat, soybeans, rice, sugar, beans, potatoes, beef and pork never before experienced.

Only farmers produce food. They will do it only if there are economic and other incentives. Farmers in the United States and throughout the world now face numerous and ever mounting numbers of economic, social, political, and environmental constraints and disincentives to food production.

The principle of free enterprise must prevail in American agriculture. The family farm is the most efficient food producing system the world has ever known. Corporate agriculture, in spite of the great visibility recently attached to it, has not met with resounding success in the USA, nor has it worked abroad. The Soviets with their state and collective agricultural enterprises have tried for 40 years to develop an efficient food producing system. Free enterprise with opportunity for profit is nonexistent in the USSR. Producing food is more than a factory operation. In addition, the Soviet Union has vast agricultural areas that are marginally too cold or too dry for stable crop production at high levels. The Soviets cannot consistently feed themselves.

### FOOD PRODUCTION RESEARCH

If food production is important, it's not reflected by current investments in research. The 1977 projected federal research and development budget assigned to the United States Department of Agriculture is approximately \$0.5 billion. This is not on par or even close to that currently projected for defense (\$9.5 billion), energy (\$3 billion), space(\$3.5 billion), or health, education, and welfare (\$2.5 billion).

A recent National Research Council report states that crop surpluses, political pressures from commodity groups, budgetary reductions, and emphasis on immediately applicable information have resulted in a formerly substantial basic research effort in the USDA-Agricultural Research Service and the State Agricultural Experiment Stations, to virtually disappear. "Fundamental research undergirding food production has languished for two decades." 15

As a nation and as an agricultural food and nutritional research community, we have been guilty of gross neglect in the very areas that hold the keys to crop and livestock productivity. The United States is no longer the leader in fundamental research on some of the biological processes that control the productivity of renewable resources.

Our agricultural technology system has been designed to support research at both ends of the applied-basic research spectrum, but not in the middle. This was the stimulus for the Michigan State University Agricultural Experiment Station with its applied-mission oriented background to join forces with the basic research scientists of the Charles F. Kettering Foundation in sponsoring an International Conference on Food Crop Productivity, October 20-24, 1975 at Harbor Springs, Michigan. The **Proceedings** of this conference relate to six biological process areas that control and limit food crop production. The focus for many new technologies should be mission oriented basic research. 16

#### NEW TECHNOLOGIES-CROP PRODUCTION

The resource base can change with time and new technology. Expanded efforts for greater photosynthetic efficiency, biological nitrogen fixation and unconventional approaches to plant breeding would literally add to the resources of the earth. Photosynthetic carbon dioxide fixation and biological nitrogen fixation are the two most important biochemical processes on earth. Photosynthesis is the source of all carbohydrates and calories consumed by man and the fossil fuels he is now exploiting. Biological nitrogen fixation provides the raw products for protein synthesis. These processes are nonpolluting. They are renewable. No limits can be ascribed as to what might be accomplished. Acquired technologies would be global in their impact and nonpolitical. These three mission oriented basic research areas are interrelated. Photosynthesis and nitrogen fixation are interdependent processes. Research on one complements the other. More carbon flow is essential if biological nitrogen fixation is to be enhanced. Moreover, since new techniques for genetic manipulation have worldwide application in the development of new and improved plants, research in all three areas should be coordinated. Results of such research investment have global interest and application and are nonpolitical. Details concerning most promising approaches in each of these three areas have been described. 17

**Photosynthesis.** Food production involves effective utilization of land and water. But it is more than that. It's a series of strategies in crop management and design to most effectively farm the sun. Plants differ dramatically in their photosynthetic efficiencies. Most crops capture only one percent of the energy from the sunlight that illuminates their leaves. The most efficient producers are sugarcane, corn, sorghum, and pearl millet. Other crops such as rice, wheat, soybeans, field beans, peas, potatoes and cotton respire twice as fast when exposed to sunlight and burn up to half the carbohydrates they produce. Not so with sugarcane, corn, sorghum and millet. They have little if any photorespiration. Ribulose diphosphate carboxylase controls photorespiration. A key to feeding the world resides with the control or regulation of a single enzyme. Biochemists and plant scientists are working feverishly, both genetically and chemically, to accomplish the task. Meanwhile, better light receiving systems for many crops are being created. Plant architecture can be changed.

Repositioning of the flag leaf above the panicle of new rice varieties is a classical example of achievement. New plant shapes can be quickly created.

The atmospheric concentration of carbon dioxide remains the most important variable determining the rate of photosynthesis in food crops. All respond. Remarkable effects occur when the normal level of 300 ppm is raised to 1000. A six-fold increase in biological nitrogen fixation for soybeans has been achieved.<sup>18</sup> While CO<sub>2</sub> enrichment is now commonplace with greenhouse-grown crops, its use has not been actively pursued as a means of maximizing the production of food crops in the field. Massive quantities of CO<sub>2</sub> are now being flared into the atmosphere, and large geological reserves are being discovered in current explorations for natural gas and oil.

**Biological Nitrogen Fixation.** The focus has been on legumes. They are major food crops and include soybeans, field beans, broad beans, mung beans, peanuts, chick peas and pigeon peas. Agricultural legumes in the United States annually fix about 12 million tons of atmospheric nitrogen per year. This is greater than the amount applied as fertilizer. Worldwide, biological nitrogen fixation by agricultural and nonagricultural species fix over 200 million tons of nitrogen for crop production. This contrasts with the world supply of approximately 40 million tons of nitrogen fertilizer, fixed chemically. The magnitude of biological nitrogen fixation under field conditions can be measured by the acetylene reduction technique. The stimulus for research on biological nitrogen fixation is the rising cost of nitrogen fertilizer, its low recovery by plants, and the massive fossil fuel (natural gas) input required for chemical fixation. 19

Opportunities for optimization lie in improvement of nitrogen fixation by legumes, the extension of this capability to additional plants, the discovery and use of new nitrogen-fixing organisms, and finding new chemical mechanisms of nitrogen fixation. There are three known sources of biologically fixed nitrogen in the rice paddies of Southeast Asia—bacteria that are rhizosphere associated, the free-living azotobacter, and the blue-green algae. Cropping systems involving interplantings of legumes and cereal grains are emerging in Southeast Asia and elsewhere as new labor intensive, high-producing food systems with a minimum of resource input and the potential for year around production. 20

**New Techniques in Plant Breeding.** Many remarkable achievements have been made in the creation of new plants. These include hybrid corn, sorghum, and millet. The development of hybrid corn is the most spectacular of all scientific achievements in American agriculture. Increases in productivity have been truly remarkable. The creation and introduction of short statured, nonlodging, photoperiodically day neutral, high yielding rice and wheat varieties have resulted in a Green Revolution. Hybrid wheat is becoming a reality. Most all commercial hybrids until now are hard, red winter types adapted to the winter wheat regions of Texas, Oklahoma, and Kansas. There has also been great progress with fruits and vegetables. This includes dwarf and spur-type apples, hybrid coconuts, hybrid onions, carrots, cabbage, spinach, melons, and parthenocarpic seedless cucumbers. 21 22 23

We are now moving beyond the horizons of conventional plant breeding. Included are the *in vitro* techniques for asexual approaches and broad crosses between crop species. Vegetative cells can now be crossed. The fused cells are then cultured for organ differentiation. New plants are then created from crosses that otherwise would be incompatible. Haploids can be produced by culturing pollen grains or anthers.

**Wide or Broad Hybridization** is listed under the heading of "radical research" in the report of the International Maize and Wheat Improvement Center (CIMMYT) in Mexico.<sup>24</sup> Quantum leaps in crop productivity will require some form of radical research. Wide hybridization is one of them. The production of specific, generic and even hybrids between plants of different families may be possible.

Barriers to wide crossing appear to be biochemical. The use of immunosuppressant chemicals to possibly circumvent this limitation is an emerging technology. Chemical control of genetic processes, particularly barriers to crossability between species and genera may be a key to rearranging genes and the synthesis and building of new crop species. The development of triticale, a synthetic species derived from a cross of wheat and rye is one success story. Triticale is superior to either parent in productivity, adaptability, and nutritional value. A much wider range of genetic variability, with less genetic vulnerability, than presently exists in food crop species will be necessary to allow plant breeders to continue crop improvement programs for the next 25-30 years. Species can be "endangered" by man but they can also be created. 25

**Chemical Regulators.** Interest for the first time in history has moved beyond the parameters of horticulture. Chemical regulation of rooting of cuttings; setting of fruit and control of flowering; flower sex expression; vegetative growth; senescence; and fruit shape, size, color, and ripening has thus far been confined largely to ornamentals, fruits and vegetables. The focus now is on the agronomic and major food crops. Leading agricultural chemical industries are interested.

There now appear to be breakthroughs for enhancement of yields of two important crops-sugarcane and corn. Seven thousand hectares of sugarcane were treated with a variety of chemical ripeners in Hawaii in 1975. Sugarcane ripeners are herbicides used at low doses. They are applied several weeks before harvest. Vegetative growth is slowed and carbohydrates (sucrose) accumulate. The resultant increase in productivity of sugar from sugarcane approximates 2 tons per hectare per year. 26

Related to the chemical ripeners for sugarcane is 4,6 dinitro-o-sec-butyl phenol (DNBP) for corn. It, along with a wetting agent, is applied as a foliar spray when the unemerged tassels are about 1/2-inch in length. Again, as with sugarcane ripeners, the vegetative growth of corn is slightly interrupted and metabolites are shifted earlier to the reproductive parts. The results are earlier pollination, more ears per plant, larger ears, and a 5-10 percent increase in grain yield. Some hybrids are very responsive. Again, DNBP is an herbicide applied as plant sprays at low dosages and at critical stages in crop development. 27

**Crop Protection and Pest Management.** Annual losses from pest (insects, weeds, diseases, nematodes, rodents, etc.) in the United States are enormous. They approach 1/4-1/3 of the total harvest. 28

Approximately one billion pounds of chemical pesticides are used annually. They still provide the foundation (over 90 percent) of contemporary pest control practice. New strategies for pest management offer promise. These include insect viruses and bacteria and chemicals (juvenile hormones) that interfere with reproductive cycles. Egg and larvae parasites, pheromones, and resistant varieties may be alternatives. The hope is for reduction in cost with fewer environmental and health hazards. 29

Heretofore, biological methods for control of weeds have been successful only on individual species. Allelopathy is an emerging technology. It is defined as mutual harm, where chemicals released by one plant species inhibit the growth of another. Allelopathy provides the opportunity to control weeds by genetically incorporating such chemical factors into desirable food crops. It has been documented for the cucumber, rye, and oats. 30 31

**Nutrient Absorption and Fertilizer Utilization.** There is inadequate knowledge concerning nutrient absorption and its control of crop productivity. Improved efficiency in fertilizer uptake is a major challenge ahead. Only 50 percent of the applied nitrogen and less than 35 percent of the phosphorus and potassium are recovered by the crop. Losses of nitrogen are even greater in the tropics with recovery averaging only 25-35 percent. Several new and high priority technologies are emerging to reduce these enormous losses. Greater efficiency in fertilizer uptake can be achieved through the use of improved cultivars with

enhanced capacities of ion uptake. Modulation of nitrification and denitrification also offer promise. Recovery and efficiency for nitrogen fertilizer can be improved by sulfur-coated urea and treated with nitrification inhibitors. One such inhibitor is known as "nitroproyrin" (2-chloro-6-(trichloromethyl) pyridine). Nitroproyrin is a highly specific bactericide which is toxic to *Nitrosomonas* bacteria. It reduces but does not eliminate the population of this organism. The reduction of nitrification lasts from six weeks up to three months. This nitrification inhibitor is under extensive trial in the tropics and for rice production in Southeast Asia. 32 33 34 35

Another promising means of improving nitrogen uptake efficiency in India is use of a product of the Neem tree. This tree produces a seed, the pulp of which is used, after the oil is extracted. It is mixed with the nitrogen fertilizer. There are identifiable bacteriocidal properties in the Neem tree product. Most nitrogen fertilizer for crops in India and Southeast Asia is in the form of urea.

Foliar absorption of nutrients, with both beneficial and harmful aspects, has taken on new significance. Little credence, however, has been heretofore attached to the process by authorities on nutrient uptake, although the author and his colleagues have published extensively on the potential role of non-root absorption in meeting the mineral nutrient requirements of food crops. The role of plant foliage in absorption of carbon dioxide has already been emphasized. The gradual lowering of the pH in atmospheric precipitation in the eastern part of the United States is having an effect on the soil as well as what is absorbed by the leaves of plants. Sulfur is seldom applied to the soil as a fertilizer because adequate quantities are absorbed directly from the atmosphere by aerial plant parts. Many other gaseous liquid and particulate materials are removed by plant foliage from the atmosphere. Some are beneficial, but more often they are air pollutants and harmful. Air quality standards in the United States have given little attention to the effects on renewable resource productivity. 36 37

There is a remarkable report on foliar fertilization of soybeans. Yields have been increased by 10 to 20 bushels per acre. The results are all the more remarkable because the yield increases were obtained from a production base that was already high and derived from the best in conventional practices. The gain was in harvestable seeds, not in increase in seed size. The ratios of nitrogen, phosphorus, potassium and sulfur in the foliar spray are the same as in the seed. Phosphate is applied as polyphosphate, and nitrogen as urea. The first spray is applied when beans can be felt in the pods of the upper four nodes. Two to three sprays are then applied 10-14 days apart. The leaves must be active and green. Nineteen gallons of solution containing 25 pounds of nitrogen, 6 pounds of P<sub>2</sub>O<sub>5</sub>, 9 pounds of K<sub>2</sub>O and 1.5 pounds of sulfur and applied either by ground or air equipment in each of three applications. These results with a major crop, confirm the long reported added efficiency of uptake associated with foliar applications of nutrients to many horticultural crops, sugarcane and pineapple; and micronutrients for major food crops. Foliar applications have been declared the most efficient method of fertilizer placement. Future yield barriers may well be broken by utilizing the absorptive capacities of leaves at crucial stages of plant development. The rising cost of nonrenewable fertilizers should be an added stimulus for the further development of this technology. 38 39

#### NEW TECHNOLOGIES-RESOURCE UTILIZATION

**Land Resources and Utilization.** Food production capacity reserves are delineated by land, water, energy, fertilizer, chemicals, capital, credit, machinery, management and technology. Food production is a renewable resource but requires nonrenewable resource inputs.

Land comes first. The productivity of land may be improved as well as depleted by cropping. To meet domestic and world food needs we have brought into production during the past three years approximately 12

million new hectares-at a cost. What cost resources would it take to bring and additional 12 million hectares into crop production? Agricultural research directors ought to be as concerned about preservation of the land base crop and livestock production as for new yield or productivity practices. A 10 percent increase in the yield of corn or wheat, or preservation of the land base by an equal percentage for its production at the same level, gives an identical result in the amount of grain produced. The resource input and flexibility in the use of the land resource, however, is quite different. Also, as we drive our land resource base harder, different kinds of problems emerge. We need to review the options in food security, prices, world trade, energy, and employment for society at different levels (quantity and quality) of a land base. 40

Irreversibility of land use for food production is becoming a national disaster. During the past 20 years, 11 million hectares have been converted into urban areas and highways. At the same time, the quality of our arable land is being slowly degraded by excess tillage and soil erosion. Losses in the United States are about 3.6 billion metric tons of top soil annually, equivalent to 31 metric tons per hectare. These soil losses are accompanied by degraded water quality, fertilizer and organic matter losses, and the silting of rivers and harbors. 41

No more than 25 percent of our farm lands are under approved conservation practices. It is not now profitable and there is little incentive for individual farmers to apply conservation practices. This must be changed.

There is one exception-reduced tillage. The no-till systems of soil management conserve soil, water, organic matter, fuel, labor, machinery and fertilizer. One of the secrets of the no-till economy is a seed drill that disturbs only enough soil in the stubble or sod from one crop to make an opening for the seed of the next crop. A still newer innovation is interseeding-sowing the seed of a second crop such as soybeans before the first one such as wheat is harvested. The concept involves complete elimination of tillage. Competing weeds are controlled with herbicides, not cultivation.

For the U.S. corn belt, no-till has proven the most effective management practice ever developed for the control of wind and water erosion. Zero tillage can be seen throughout the United States for corn, soybeans and sugar beets. It is effective for asparagus. No-tillage farming has spread to more than three million hectares in the United States. Minimum tillage technologies now embrace more than 18 million hectares in the U.S. It is projected that more than half of America's cropland will be farmed without plowing in thirty years. Much additional land can now be used for crop production formerly not considered suitable. It is now used for small grains in Britain, rice in Southeast Asia, and provides an improved system of land management for highly erodible and difficult-to-manage tropical soils. Entire issues of professional and trade journals are devoted to the topic. The advantages of reduced tillage which come through most clearly to the producer are the (a) saving of time, (b) reduction of costs, (c) greater land utilization, (d) quick turn around time from one crop to the next, and (e) taking advantage of short spells of good planting weather. 42

**Water Resources and Utilization.** It is estimated that in the United States 90 percent of all water that is withdrawn from streams and ground water storage for use is consumed in irrigated agriculture. Eighty-one percent of the sugar beets, 70 percent of the fruits and vegetables, 40 percent of the cotton and sorghum, 30 percent of the alfalfa, 25 percent of the barley and 10 percent of the corn and wheat produced in the United States is from land that is irrigated. In view of the predominate use of water in food producing systems it is somewhat ironical that the 1975 Staff Draft Report of the National Commission on Water Quality does not address itself to water quality for agriculture. All other aspects of water quality ("fishability," "swimability," leisure, human health, etc.) are, however, given thorough treatment. 43

Irrigated land generally is the most productive, up to 30

percent of the food for mankind is produced on about 15 percent of the irrigated cultivated land of the globe. Irrigated acreages in the Peoples' Republic of China, the USSR and India exceed those in the U.S. Agriculture, other than dryland grazing and dryland farming, would be nonexistent in the western USA without irrigation.

Agriculture suffers from some degree of water deficiency over the entire globe. Drought is one of the major factors contributing to food shortages and instability of supplies. While billions of dollars have been expended for development of new land resources through irrigation, little attention has been directed toward increasing efficiency of water usage by crops and new technologies for water management. Efficiency in usage of irrigation water varies from a low of 30-40 percent in the United States to more than 80 percent in Israel. The amount of water required to produce a unit of food is also a variable. In the Hawaiian Islands only 18-20 inches of rainfall is required annually for pineapple but for sugarcane it is 90-100 inches per year.

An improved system of water management is trickle or drip irrigation. It had its origin 25 years ago in the greenhouses of western Europe. Only in the 1970s, however, has it been introduced for production of high value crops in the field. It is irrigating the crop not the soil. Quantities of water required to start young orchards in the desert may be reduced to 1/20th of conventional sprinkling systems. For sugarcane, corn and sorghum, nutrients may be added through the system and the lines may be buried 12-18 inches deep to discourage weed growth.

Drip irrigation is being installed in the sugarcane plantations of Hawaii at the rate of 5,000 hectares per year. All new plantings are equipped with the drip system. The total estimated cost of \$1,500 per hectare is amortized in one year as a result of savings in labor. Drip irrigation will eventually be installed in all sugar plantations of Hawaii (50,000 hectares) that are currently irrigated. This water conserving-labor saving technology needs careful evaluation for other major food crops as well as high value fruits and vegetables.

**Energy Resources and Product Utilization.** The importance of energy options with land, water, and labor in food systems has been emphasized. While food production is more than energy and protein, the two are closely related. Use of agricultural by-products and hydrolysis of waste cellulose could add enormously to our food and fuel sources. Economic viability will determine the rapidity with which such technologies are developed.

Meanwhile, studies of energy inputs into alternative agricultural production techniques for the major food crops and their products, should be pursued on a national and global scale. Improved food processing efficiency could reduce energy use by 35 percent, waste and effluent by 80 percent, and increase processing yields by 5-20 percent. Total losses between harvest and consumption could be reduced by 30-50 percent. 44 45 46

## NEW TECHNOLOGIES-LIVESTOCK PRODUCTION

Domestic animals produce meat, milk, and eggs from nutrients derived from crops, forages and by-products that have less value elsewhere. The magnitude of the current contribution of animal products to the U.S. food supply is significant. They produce 2/3 of the protein, 1/3 of the energy, 1/2 of the fat, 4/5 of the calcium and 2/3 of the phosphorus consumed by man. 47

**Make Ruminants Less Competitive With Man for Protein and Energy.** Cattle (beef and dairy), sheep and goats can grow and produce primarily from plant foods that cannot be consumed by man, but are converted to useful products (meat, milk, hides, wool). The rumen stomach is essentially a fermentation vat. Nonprotein nitrogen sources (anhydrous ammonia, ammonia solutions, urea) can be added to whole chopped corn plants and other forages in the field or at the silo. If done at the proper stage of maturity sufficient energy and nitrogen is provided for finishing beef cattle and all but the very high

producing dairy cows. Only 12-15 percent of the nation's corn crop is currently harvested as silage. A vast new energy resource could be put to use. Forages now constitute about 3/4 of the feed units consumed by ruminants (beef cattle, dairy cows, sheep, goats). This could be raised to an even higher level with an effort directed toward improved management of range lands and pastures coupled with the development of superior grasses and legumes, and improved harvest technologies. Targets of opportunity in these areas have been outlined. 48

Ruminant livestock do not have to compete with man for energy or for protein. Large quantities of grain have been fed to livestock in the past only because it was in surplus and it was economically feasible to do so. Forages can be produced on vast areas of land that globally exceed by two-fold that suitable for cultivated crops. Only ruminant animals can convert these forages to human food. One of the greatest research challenges is to increase the efficiency of this conversion. The ultimate goal may be control of rumen fermentation to optimize the production of desirable end products. 49

**Improved Animal Health.** Prenatal immunization of the unborn dairy calf is now a reality. This is an insurance against calfhood disease. A worldwide record for speed of adoption of a new technology was recently achieved in the history of agricultural science. A vaccine for Marek's disease was first introduced by a team of four scientists in 1971. It is a vaccine that will control a type of cancer in chickens. This contribution to the health of laying hens and broilers is now being studied for possible adaptation to human health problems relating to the control of cancer.

**Improved Fertility.** Closely allied to disease control is high reproductive performance. A new frontier is emerging for fertility control in dairy and beef cattle and for horses. Prostaglandin F<sub>2a</sub> controls estrus and greatly improves efficiency of artificial insemination. An approved commercial use has already been introduced for horses and final clinical tests are underway for dairy and beef cattle. Ovulation control with prostaglandin F<sub>2a</sub> will permit artificial insemination in herds where detection of estrus is now difficult or impossible. The potentials lie in rapid genetic improvement and for greater reproductive efficiency. The implications of this discovery are global. This may be the long awaited technological breakthrough for improving the notoriously low fertility of the water buffalo in Southeast Asia, and in other parts of the world.

## CONCLUSIONS

Modern food systems must be viewed in their total

context. The production of a commodity begins with the seed, land, water, fertilizer and pesticides. It requires machinery, capital, labor and often credit. This assemblage on the farm demands superb management. The natural resources, some nonrenewable (land, water, energy, fertilizer), and some renewable (sunlight) are utilized. The vagaries of weather and climate must be dealt with. The farmer must put it all together and make it work. Raw agricultural products (corn, wheat, soybeans, beef, pork, milk, poultry, eggs, fruits, vegetables, cotton, etc.) are produced. They must be harvested. They then move beyond the farm to processing, packaging, transportation, storage, and distribution to consumers everywhere.

There are many technological solutions to the world food problem. One is impressed by the number of potentially important and viable alternatives. We have emphasized the development of new agricultural technologies for enhancement of food production as our best hope for the future. These advances, however, will be of little value without the free enterprise system, the family farm and economic and social incentives to produce food. There must also be the political will.

Agricultural productivity as a renewable resource, the adequacy of our food supply, and improved nutrition will assume an increasingly greater importance and visibility. Never in the history of mankind has one nation had such a monopoly on food. Never has a single nation exported so much food. This nation has never experienced a famine. Today's generation has never known hardship or witnessed a shortage of food, shelter or clothing. Never before in history has there been such an interest in agriculture, food, and nutrition. College and university enrollments in agriculture and renewable resources have doubled in five years.

Recent records of accomplishments in food production have never been equalled by any nation in the history of mankind. Agricultural, food and nutrition education must be expanded rapidly to meet current demands and an escalating interest. Otherwise, those with nonagricultural backgrounds will be prone to take over. There is already the perception that the present agricultural establishment is obsolete and incapable of meeting today's problems in the food area. Never was there a greater need and opportunity for qualified and trained people. To meet the food requirements of an expanding population, quantum jumps even greater than we have thus far witnessed must be achieved in agricultural productivity during the next 25 years. I am confident that we can meet these challenges.

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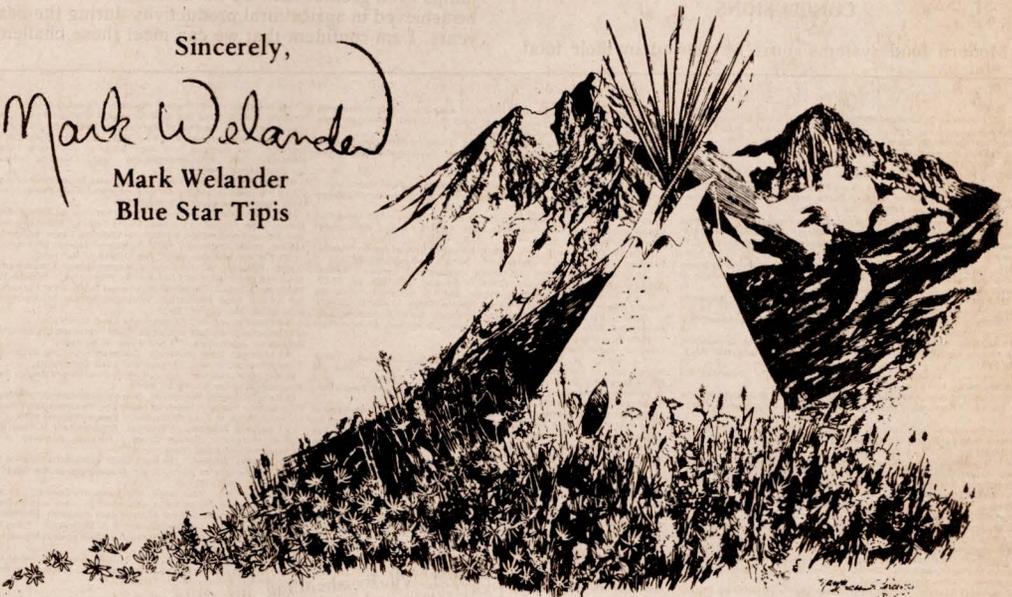
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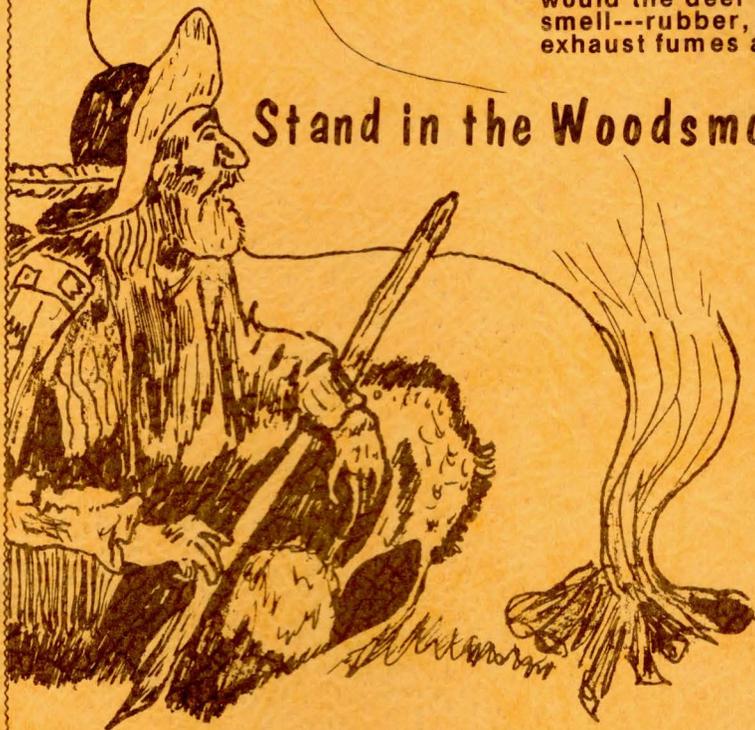
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