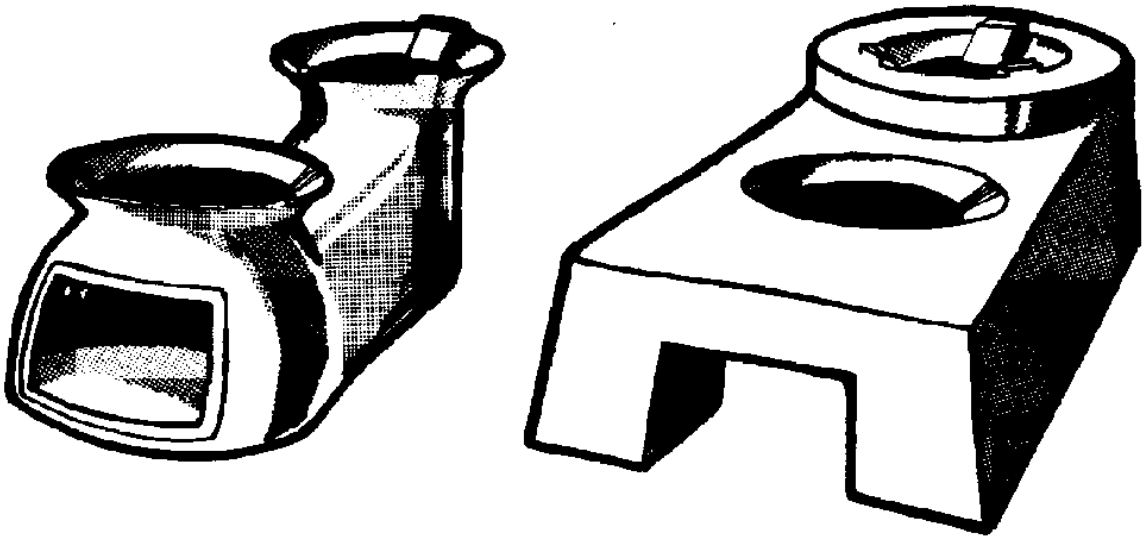

Energy: Improved Cookstoves and Charcoal Productions

The world's forests are shrinking under tremendous pressure from agricultural and lumbering activities. In some areas, the intensifying search for fuelwood, the primary cooking fuel for the South, is an important contributor to the problem. Most of this wood is burned in open fires or inefficient stoves. When wood is simply too expensive or too far away, animal manures and crop residues formerly returned to the soil as fertilizers frequently are burned as fuel instead. This practice, increasingly common in many parts of Africa and South Asia, adds to a downward spiral in soil fertility. Once the trees and vegetation on hillsides are removed, soil erosion proceeds rapidly with rain water runoff and flooding, and the land can be turned into a desert. Current patterns of daily firewood consumption around the world are thus important factors in an advancing environmental crisis.

Since the late 1970's, much work has been done on the design and dissemination of simple, low-cost improved cookstoves. Such stoves can save up to 40% of the wood fuel normally consumed in open fires, and 25-35% of the fuel consumed in typical traditional stoves. The collective experience of this work is described in **Burning Issues**. *After much enthusiastic pursuit of a variety of strategies to encourage owner-building of stoves, experienced observers are concluding that the small industry production of stoves is one of the most promising routes to take. The advantages of this approach include better quality control and therefore higher efficiency and longer stove life than can be achieved with owner-building. Costing $1-5 each, the stoves can often pay for themselves in*

fuel savings within 1-2 months if the fuel is purchased. In rural areas where most fuel is gathered, very low-cost stoves can still be sold to some people, but the distribution problem is much more difficult, and clearly successful strategies have yet to be worked out.

Fuel conservation through improved cookstoves appears to be the cheapest way for a nation to invest in new sources of energy. The typical artisan-produced cookstove conserving 35% of fuelwood costs less than $5. Three improved stoves have the same effect on fuel supply as one family biogas plant (which would cost 40-50 times as much)—both mean that one additional family's cooking fuel needs can be supplied. The capital investment will be higher for electric or kerosene stoves, and one must also consider the cost of adding to the electrical generating capacity and extending the electrical grid. Both electric and kerosene stoves have the added daily cost of fuel, which in the case of the improved stove is nil (because improved efficiency alone accounts for all of the gain). The common subsidies and the foreign exchange requirements make kerosene imports burdensome for the national economies of many countries.

The secondary effects of existing cooking systems must be understood before acceptable improvements can be made. In many places, smoke from indoor cooking fires is a significant contributor to lung and eye disease. Yet this smoke also serves to dry crops hung over the cooking area and to protect thatched roofs from insect damage. In highland regions and other colder areas, the space heating function of the indoor cooking fire may need to be included in cookstove design. Successful stove promotion efforts may depend on the availability of effective alterations for these secondary functions of the cooking fire.

Experience has shown that despite the need for wood conservation on a massive scale, adoption of improved stoves cannot occur immediately for an entire nation or region. It will, instead, depend on involvement of local people in careful, systematic work which emphasizes testing and cooking methods. Existing stoves and new prototypes can be tested with a minimum of equipment. Testing techniques are covered by several of the books in this section.

Most knowledgeable people have revised their estimates of the fuel savings possible with the typical new stove. A 35% savings is now considered a realistic figure for the better stove designs. Similarly, most agree that the distribution of improved stoves alone is not going to greatly affect the rate of deforestation in most places. Nevertheless, improved cookstoves are now considered to be a cost-effective component in reforestation programs in some countries, and clearly they have a role to play in improving the quality of life by conserving family resources of cash and time, and reducing smoke in the cooking area.

Many of the entries in this section provide ideas and construction details for a variety of low-cost cookstove designs. **A Woodstove Compendium** *is a good introduction to the range of design choices, and it nicely describes the physics of the cooking fire.*

Improved Wood, Waste and Charcoal Burning Stoves *is an outstanding reference book for practitioners running programs to improve stoves. It gives a valuable sense of what has and has not worked around the world, and the elements that should be incorporated into a successful program.* **Technology, Markets and People: The Use and Misuse of Fuelsaving Stoves** *is another book to be read by all who would manage stoves programs.*

In the rural areas of developing countries, rice husks (or hulls) not consumed as fuel are usually returned to the soil or used as a binder in building materials such as bricks. **Rice Husk Conversion to Energy** *notes that most rice hulls are already*

being used in one way or another, and that only about half of the remainder could be used. There is much work to be done, though, in the search for more efficient rice hull burning methods. (See **Rice Hulls as a Fuel** *for 18 stoves and kilns from Southeast Asia.)*

Charcoal has a high energy content per unit of weight and is thus easier than wood to transport long distances. When fuelwood hauling becomes a serious problem in communities in developing countries, charcoal production tends to increase significantly, so that more fuel energy can be transported in a single load. Charcoal contains less energy than the wood from which it is made, because energy is required to fire the kiln and volatile gasses are removed. Included in this chapter are several publications on making and using improved kilns which produce more charcoal from the same amount of wood than most traditional kilns and pit-fired techniques.

Burning Issues: Implementing Pilot Stove Programmes, A Guide for Eastern Africa, MF 20-464, book, 184 pages, by Stephen Joseph and Philip Hassrick, ITDG, 1984, out of print.

Whereas much has been written elsewhere about the design, testing, and construction of improved cookstoves, there is little available on how to start up and manage a program to disseminate new stoves. This book fills the gap by drawing together the experiences of many stoves programs in Africa and Asia, and summarizing important management principles and options that have proven to be successful. Needs assessment, training workers, extension, marketing, monitoring and evaluation are all discussed. Although this was not intended to be a design guide, the material on options and matching stoves to needs and resources is good.

"In Kenya, successful market demonstrations have been held with the Ministry of Energy's pottery-lined charcoal jiko. Side by side with the traditional jiko, the two stoves simultaneously cook the same size pot of beans. The women watching determine when to open and close the doors, add fuel, and add water to the beans. The stoves start out with equivalent piles of charcoal and it becomes readily apparent that less charcoal is added to the improved jiko."

"It is important to have stoves available for sale at the time of inciting interest by offering such obvious proof of a good product. 'What good does this do for us?' people ask if you have no stoves for sale."

Recommended.

Helping People in Poor Countries Develop Fuel Saving Cookstoves, MF 20-448, book, 148 pages, by Aprovecho Institute, 1980, free to serious groups from German Agency for Technical Cooperation (GTZ), P.O. Box 5180, 6236 Eschborn 1, Federal Republic of Germany.

Aprovecho's involvement in the development of fuel-saving stoves in Guatemala resulted in publication of **Lorena Owner Built Stoves** (see review). Since that experience, Aprovecho has carried out further research on how Lorena and other low-cost stoves might be improved, and continues to provide assistance to cookstove popularization efforts in other developing countries.

This book is about such efforts, written for field workers (such as volunteers and extension agents), administrators and planners (especially those responsible for forestry and soil conservation programs), and researchers. The purpose of the

manual is not to present construction methods in detail for specific stoves. Instead, the emphasis is on how to encourage poor people to develop solutions to their problems, with the focus on cooking technologies. Topics covered include important background information on how deforestation, declining agricultural production, and stagnating rural economies are related; working with villagers to design stoves; and systems for spreading information and training stove builders.

"There are as many ways of going about dissemination as there are cultures, but (several points covered here are) raising public awareness; setting up an approach for dissemination; where to go for help in distributing information; promotion: ideas to try; where and how to start dissemination; setting up stove centers; training; involving women; evaluation and follow-up; use training; sponsoring and advising small businesses"

Three final chapters discuss how woodstoves work and how to design simple comparative stove testing procedures, and provide brief illustrated instructions for building a variety of Lorena, clay, metal, and other stoves.

Historically, efforts to introduce "appropriate technology" have relied on convincing people that they need a manufactured product. This valuable book is a down-to-earth discussion of how development workers can help people make use of their own ideas about what they need to develop an improved technology for themselves.

The Socio-Economic Context of Fuelwood Use in Small Communities, Special Study #1, MF 20-475, book, 293 pages, by Dennis Wood et. al., 1980, publication no. PNAAH747, $2.00 from AID Document and Information Handling Facility, 7222 47th Street, Suite 102, Chevy Chase, Maryland 20815, USA.

"Community fuelwood programs should take into account the socioeconomic organization and the environmental constraints and potentials of each community; usually little attention is paid to these critical village-level aspects." This is a summary of the literature on these aspects of fuelwood use in developing countries, and the problems commonly encountered by fuelwood programs. It should be useful background reading for people involved in fuelwood, reforestation, and cookstove programs, to help them better understand what is actually going on in rural areas and why.

Technology, Markets and People: **The Use and Misuse of Fuelsaving Stoves**, UNEP Energy Report Series Volume 18, MF 20-479,1989, book, 46 pages, Bellerive Foundation, available from UNEP Information and Public Affairs, P.O. Box 30552, Nairobi, Kenya.

Here is an exploration of the real ground-level problems and confused information that face people managing improved stoves and reforestation programs. The authors relate a variety of cautionary stories about such things as anecdotal fuelwood prices that proved to be exaggerated, and stove makers who, once trained, had no market for their skills because there was no tradition of custom construction work in homes. The authors identify flexibility in project activities as one of the most important keys to making a useful contribution.

On improved stoves: "It may seem paradoxical to begin considering dissemination before we have developed or identified a product to disseminate, but that is precisely what we are advocating. It seems less paradoxical when we recall that designing improved stoves never seems to have presented very many

problems, while designing effective dissemination mechanisms certainly has."

On afforestation: "Our priority must be to target the seedlings towards individuals who will look after them. Left untended, they have an extremely poor chance of survival. This targeting should be relatively easy to achieve, but involves a move which many rural afforestation programmes may find unpalatable: the use of price as a means of controlling seedling distribution .... If ... we set the price of the seedlings such that it becomes a substantial factor in the decision as to how many to buy, then the individual will only purchase seedlings up to the number he/she can afford to look after .... The other attractive feature of charging a higher price for the seedlings is that private-sector seedling production then becomes a possibility in the long term. No one is going to set up in the business of seedling production as long as the project is distributing them for free."

But, on the other hand, "... if all the trees supplied are healthy and well-tended but concentrated in the compounds of the four well-off farmers who could afford the seedlings, then the programme may not be contributing towards the community development priorities of the district."

A thought-provoking piece for people who are involved in or considering becoming involved in these activities.

Testing the Efficiency of Wood-Burning Cookstoves: International Standards, MF 20-459, book, 75 pages, 1983, $9.75 (overseas orders add $3.00 for surface mail, $5.00 for airmail) from VITA; also available in French and Spanish.

The procedures outlined in this manual were developed by a group of experienced stove workers with the hope of standardizing worldwide testing to the point where the efficiencies of stoves developed in different areas can be usefully compared. It is recognized that there is a tradeoff between tests which cover the widest possible range of cooking applications and those with the closest possible fit with local cooking practices. Three tests are presented with complete instructions, including forms for data collection and reporting. The authors stress that the tests are provisional, and that they seek feedback to help improve the standards.

Testing Timber for Moisture Content, MF 20-478, booklet, 31 pages, CSIRO, 1974, out of print.

Some cookstove improvement programs use moisture meters to measure wood fuel moisture content before cookstove tests. This allows a more accurate comparison of tests of different stoves that take place at different times using wood from different sources. This booklet explains the simple steps necessary to ensure that accurate readings of wood moisture content are obtained from proper use of the moisture meter. Instructions for proper testing by oven drying are also provided.

"Test the electrode circuit regularly by bridging the electrodes with your hand; the meter should then show an apparent high moisture content .... Take several readings in different parts of a board to check evenness of drying."

This booklet will also be of interest to furniture and cabinet makers, who need to control swelling and shrinking of wood in their products.

Designing a Test Procedure for Domestic Woodburning Stoves, Interim Report No.1, MF 20-443, booklet, 53 pages, by Stephen Joseph and Yvonne Shanahan, 1980, £1.50 from ITDG.

This report was written to help people develop procedures for testing woodburning stoves. Treatment of laboratory testing procedures for various measurements of efficiency is good but in some cases complicated. Most of the tests can be carried out with simple apparatus (thermometer, scale, watch, ruler). Useful appendices include "Standard Test Method," "Laboratory Test Data Sheets," "Example of Area Profile," and "Example of a Stove Checklist."

Guidelines on Evaluating the Fuel Consumption of Improved Cookstoves MF 20-447, booklet, 30 pages, Aprovecho, 1981, publication PN-AAJ-811, $4.82 from AID/DIHF, 7222 47th Street, Suite 102, Chevy Chase, Maryland 20815, USA.

Evaluation is an important but often neglected component of programs which develop and disseminate improved cookstoves. Most published techniques for evaluation have focused on calculating "efficiencies" of the stove. This manual focuses instead upon how to evaluate stoves within the village or city setting in which they are being used. Information is collected at a household level, without complicated apparatus or calculations.

Recommended.

Improved Wood, Waste and Charcoal Burning Stoves: A Practitioners' Manual, MF 20-484, book, 229 pages, by Bill Stewart et. al., 1987, £12.50 from ITDG.

This is the best book available on improved stoves, for people involved in running programs, with valuable insights into how to make a program successful. It covers the important designs that have evolved in the last ten to fifteen years and the field experience with these stoves.

Initial assessment of local need and circumstances, choice of stove design, laboratory and kitchen testing, production, and marketing are major topics. Twenty-one stove designs are reviewed.

"For all stoves it is important to work out whether the stove will 'pay'; that is, will the benefits people get out of the stove more than compensate for the costs in money, time or effort spent in acquiring it. Any stove that is perceived not to be 'worth it' will not catch on, and as soon as subsidies are removed it will disappear without a trace."

"Perceptions are all-important here. While we may be able to show in a laboratory that a stove can save fuel or time or reduce smoke in the kitchen, it is people's perceptions of these savings that will determine their willingness to purchase or install one and to recommend it to their friends. For example, a saving of 20% of fuelwood might be perceived as no savings at all, while in some programs savings of 30% have been perceived as substantial."

A Woodstove Compendium, MF 20-462, book, 379 pages, by G. De Lepeleire, K. Krishna Prasad, P. Verhaart, P. Visser, Wood-Burning Stove Group, 1981, $12.00 from the Eindhoven Institute of Technology, Wood-Burning Stove Group, Den Dolech 2, P.O. Box 513, 5600 MB Eindhoven, The Netherlands.

This compendium is the most complete work to date on woodburning cookstoves, and we highly recommend it. The authors begin with a clear and simple explanation of how food is cooked, how wood burns, and basic considerations affecting combustion, efficiency, and the structural integrity of woodburning cookstoves. This is followed by data on construction, fuel, testing results, etc. (depending upon available information) for over 100 new and traditional cookstoves. Diagrams of each are usually sufficient to convey the basic design characteristics, and references lead the reader to one or more of nearly 100 bibliographic entries (no ordering information, though). There is, however, no information from comparative tests of these stoves. The final third of the book takes a more technical and in-depth approach to design considerations, and is written with engineers, rather than generalists, in mind. Evaluation is briefly discussed, and useful forms for data collection are presented. Citing the importance of intricacies of design and quality control, the authors argue for stove development to be carried out by engineers and building to be done by trained specialists, rather than by the owner.

Modern Stoves for All, MF 20-453, book, 87 pages, by Waclaw Micuta, revised 1985, $8.95 (add 10% in Europe, 15% elsewhere for postage) Mom Bellerive Foundation, Case Postale 6, CH-1211 Geneva 3, Switzerland; also From ITDG.

This important manual begins with an easily understood discussion of combustion of wood and considerations for design of woodburning stoves. Part Two discusses different types of pots and alternative fuels such as briquettes pressed from materials such as dry weeds, husks, cotton waste, coconut fiber, sawdust and municipal garbage. A simple diagram of a hand press for briquette production is included. Part Three presents 12 stove models from Africa, Europe, and Thailand, and methods for testing efficiency.

Wood Stoves: How to Make and Use Them, MF 20-461, book, 194 pages, by Ole Wik, 1977, Alaska Northwest Publishing Company, out of print.

Unlike most North American books on woodstoves, this one is concerned with making stoves. It also contains many ideas on design and construction of cooking stoves, which tend to be ignored in the literature. Those people experimenting with the design of improved efficiency cookstoves will certainly want to read this book.

Only metal stoves, requiring purchased metal stovepipe and made primarily from discarded oil drums, are discussed. In the South, these stoves are expensive to build and corrode quickly. In addition, this book is based on years of experience in a very cold climate where wood is abundant and efficiency of combustion is not as important as in most semi-deforested regions. Also, protecting the cook and kitchen from excess heat is of little concern to the author. Designers using this book in developing countries will want to keep these differences in mind.

Cookstove Handbook (Pilot Edition), MF 20-441, book, 247 pages, June 1982, write for exchange, N.K. Gopalakrishnan, Tata Energy Research Institute, Documentation Centre, Bombay House, 24 Homi Mody Street, Bombay 400 023, India.

This is primarily a compendium of more than 40 cookstoves. Several diagrams are presented for most stove models, with comments on fuel, materials, advantages, and disadvantages. This handbook is a survey of stoves and thus may provide new ideas for design, but it is not a construction manual. Many of the stove models are taken from other publications, which would be better sources for design details, as well as background information related to each stove. There is some discussion of design considerations and the principles of combustion, and 14 laboratory tests are presented in a standardized format.

Wood Conserving Cook Stoves: A Design Guide, MF 20-460, book, 111 pages, VITA, 1980, out of print.

The first half of this book gives construction and cooking procedures for four fuel conserving cookstoves: a Lorena stove, a smokeless chula, a Singer stove, and a sawdust stove made from a rectangular 5-gallon can and sheet metal. Construction information is not detailed, but includes good drawings that can be followed by someone with good manual skills.

More detailed information on each of these stoves can be found in other publications. This book is valuable because it explains in non-technical English how fuel provides heat as it burns, and how traditional and improved stove designs contain this process and direct the transfer of heat for maximum cooking advantage. The chapter "How to make stoves efficient" explains how stoves lose heat energy and how these losses can be reduced by modifications in combustion chamber, chimney, damper, wall, and pothole design.

Clear and well-illustrated.

Wood Conserving Cook Stoves Bibliography, MF 20-476, paper, 31 pages, VITA, November 1983, out of print.

200 articles, reports and books on wood stoves are listed, with a short description of each. Copies of half of the entries can be obtained from VITA.

New Nepali Cooking Stoves, MF 20-454, booklet, 19 pages, by Andreas Bachmann, UNICEF/Nepal, out of print.

This booklet explains and diagrams a stove with prefabricated components which is being introduced in rural areas of Nepal. A potter who has received special training makes the stove body and pipes out of clay. These parts are fired and then assembled in the home. A rock or brick aggregate is packed around the fired parts to give the stove mass. This promising approach to cookstove dissemination has the potential to overcome problems of poor quality control experienced in many large mud stove dissemination projects. Other sources of information on improved and prefabricated cookstoves are listed at the end.

Recommended.

From Lorena to a Mountain of Fire, MF 20-446, booklet, 52 pages, by Marcus Kaufman, 1983, $12.00 postpaid from Publication Section, Yayasan Dian Desa, P.O. Box 19, Bulaksumur, Yogyakarta, Indonesia.

Over the course of five years of improved woodstove dissemination in Central Java, Dian Desa—a local A.T. group—moved away from a monolithic Arena stove based on the Guatemalan model to progressively smaller and simpler stoves, better matched to local cooking patterns. The need for standardization and quality control of large numbers of stoves eventually led the project to adopt a simple pottery-liner approach, allowing for widespread dissemination without requiring a large number of highly trained field workers. This is a case study, not a construction manual, and it is hoped people doing stove work elsewhere can learn from Dian Desa's experience.

Recommended.

One Pot, Two Pot...Jackpot: Some Suggestions for Future Directions for Woodburning Stoves in Sri Lanka, MF 20-473, book, 49 pages, by Simon Burns, 1985, ITDG Stoves Programme internal publication (but available for purchase to the public), £5.50 from ITDG.

Burne presents an interesting discussion of the advantages of single-piece two-pot ceramic stove liners as a design option in Sri Lanka. Training and marketing needs are explored. Many of the observations about economics and marketing have implications for stoves programs in other countries, particularly those involved with pottery stoves.

Recommended.

Report on Training of District Extensionists, MF 20-474, book, 48 pages, internal publication of ITDG Stoves Programme, 1985, £5.50 Mom ITDG Stoves Programme, Myson House, Railway Terrace, Rugby CV21 3HT, United Kingdom.

Large-scale stove promotion programs have substantial training needs for staff members and for potters or production workers. This report contains material used in training stove promoters who work with potters, as part of the Sarvodaya/CEB stove program in Sri Lanka. Advice is given on how to select potters and work with them, how the pottery stove production process works, and where there are likely to be problems.

Lab Tests of Fired Clay Stoves, the Economics of Improved Stoves, and Steady State Heat Loss from Massive Stoves, MF 20-471, paper, 48 pages, by Georges Yameogo et. al., November 1982, CILSS/VITA, out of print.

Five single-pot chimneyless ceramic stoves were laboratory tested and compared with the performance of an open fire. All the stoves saved at least 50% of the wood, while the best stove saved 2/3 of the wood. Cooking performance tests are not covered. Drawings and descriptions of the stoves are provided, along with the test data. The financial attractiveness of stoves is also explored, assuming various interest and discount rates. The authors conclude that very low-cost stoves, even with a short lifetime, are the most financially attractive. A brief discussion of heat loss and stove wall thickness is included.

Comparison of Improved Stoves: Lab, Controlled Cooking, and Family Compound Tests, MF 20-467, book, 67 pages, by Georges Yameogo et. al., IVE/ THE/GTZ/CILSS/VITA, 1983, out of print.

A team that tested a variety of stoves in the Sahel concluded that lightweight, single-pot, chimneyless metal and ceramic stoves had the greatest potential for fuel savings (40-50%), while the more massive 2 or 3-pot chimney stoves would use as much or more firewood than the open fire if the cook attempted to boil on the second pothole.

"Chimneyless stoves have A) more surface area of the pot exposed to the hot gases, B) a shape that also forces the hot gases close to the surface of the pot to improve convective heat transfer, C) grates to improve combustion and D) low mass to reduce the amount of energy needed to heat the stove body itself."

Test methodology and results, sample data sheets and drawings of all of the tested stoves are included.

The Kenya Ceramic Jiko: A Manual for Stovemakers, MF 20-480, book, 99 pages, by Hugh Allen, 1991, ITDG (in association with ATI and CARE), £9.95 from ITDG.

Many stove designs have been promoted as "the" best stove for everyone, but few have truly broad applicability. Yet the Kenya ceramic jiko should probably be on anyone's short list of designs, because it has so many promising features. It is small and portable, relatively efficient and durable, yet rather low-cost. It burns "25 to 40 percent less charcoal" than the traditional stoves on which its design was based. The combination of ceramic materials inside a metal body results in a durability that all ceramic stoves and all-metal stoves lack. Now in production in at least seven African countries, at a rate of at least 8000 units per month, this is an interesting survivor of the stoves development efforts of the past decade.

This manual is dedicated to exploring the conditions under which this stove design seems to be desirable, and showing how the stove is made. The metal case of the stove is fabricated in a straightforward manner. The ceramic liner, on the other hand, requires the use of good clay materials, a special locally made wheel with molds and shaping tools (jigger jolly, plans provided) to turn out substantial volumes, and effective kilns for firing. While a considerable amount of information on kiln design and construction is provided, this is in itself a challenging topic covered in more depth elsewhere.

Lorena Owner-Built Stoves, MF 20-452, book, 144 pages, by Ianto Evans and Michael Boutette, 1981, published by A.T. Project, Volunteers in Asia, $5.00.

"What is the Lorena stove? It is a permanent cookstove made with a mixture of sand and clay. Almost anyone can build it, without special tools, at almost no cost and with only this book or a few days training" This inexpensive stove, originally developed in highland Guatemala, was designed for improved fuel efficiency using a variety of organic waste fuels in addition to wood.

In illustrated step-by-step fashion, this manual explains Lorena stove construction: how to test for suitable sand-clay mixtures, design the stove, and build and carve out the sand-clay block. Cooking methods and possible design modifications are suggested. A final section describing research on acceptance and use of the stove by Guatemalans shows that builders continually alter the designs. These innovations improve (rather than reduce) fuel efficiency only when builders

and users fully understand how the stoves work. Training courses must therefore communicate the operating principles in addition to the construction techniques.

The 1981 revised edition incorporates some designs from Java and an appendix on evaluating fuel savings and testing at the village level. Another appendix describes and illustrates rice hull burning stoves from Java.

After years of experimentation and field testing, in many countries the Lorena stove now represents an early prototype that has since been abandoned in favor of stoves designed for cooking and eating habits for these areas.

Laboratory and Field Testing of Monolithic Mud Stoves, Interim Report No. 3.2, MF 20-451, booklet, 50 pages, by Joseph and Y.J. Shanahan, ITDG Stoves Program, out of print.

This report presents the conclusions of field tests on the Chula and Lorena stoves in Sri Lanka and Indonesia, along with details of testing and conclusions from laboratory tests. Procedures were based upon the ITDG report **Designing a Test Procedure for Domestic Stoves** (this section). Discussion includes effects upon performance of stove size, combustion chamber size, shape and chimney design; length and shape of connection flues; pot hole size and shape; and chimney design. Useful design guidelines are presented. Also includes a discussion of three-stone fireplaces.

Cookstove Construction by the Terra-CETA Method, MF 20-440, booklet, 6 pages, by Roberto Lou Ma, 1982, Centro de Experimentation en Tecnologia Apropiada, Guatemala, out of print.

Recognizing the difficulty in disseminating large numbers of well-built cookstoves, CETA developed an adjustable mold design which will allow rapid production of clay/sand stoves, through a rammed-earth type method. The pot holes and firebox are formed by removable inserts. This seems to be a promising alternative to ceramic inserts (see **New Nepali Cooking Stoves**, this section) for those wishing to simplify or standardize stove construction.

Brief Notes on the Design and Construction of Woodburning Cookstoves, with Particular Reference to the CETA System, MF 20437, booklet, 11 pages, by Roberto Lou Ma, 1982, Centro de Experimentation en Tecnologia Apropiada, 15 Avenida 14-61, Zona 10, Guatemala City, Guatemala, out of print.

CETA, working in Guatemala, home of the original "Lorena" stove, has developed a method for cookstove construction which facilitates rapid construction through a modular design, with the critical components produced centrally by a local artisan. Although this approach may be of higher cost for materials, the on-site set-up of this stove would be simple and quick. Standardized production, the author points out, makes possible greater quality control. See also the more recent paper, **Cookstove Construction by the Terra-CETA Method** in this section.

A Cooking Place for Large-Sized Pots, MF 20-469, booklet, 28 pages, by Andreas Bachmann and Thondup D. Kongtsa, 1984, UNICEF, Kathmandu, Nepal, out of print.

Small cottage industries are often large users of firewood, for dyeing wool, paper-making, and many other kinds of processing. This fact has led some observers to propose alternative fuel sources (e.g. biogas, producer gas, water turbine-driven heat generators) that typically have high investment costs for the amount of wood fuel saved. Relatively simple, low-cost large stoves can significantly reduce fuel consumption. Such stoves are relatively familiar and require a much lower investment for the energy saved than does virtually any other alternative. The promotion of such stoves should be the first priority of programs to reduce cottage industry fuel use.

This booklet describes and provides drawings for one such stove that was designed for wool-dyeing in Nepal. The stove requires 2000 bricks, a cast-iron grate, and a brick or metal chimney.

How to Build an Oil Barrel Stove, MF 20-449, booklet, 24 pages, by Ole Wik, Alaska Northwest Publishing Company, out of print.

This woodburning stove is primarily for cooking. Whereas most oil-drum stove designs retain the round shape of the drum, this design is a rectangular shape which provides the user with a fairly large cooking surface.

"The author has provided simple directions for making this stove ... requiring shaping and assembling 12 pieces of metal cut from a discarded oil barrel, entirely without welding equipment or power tools." Very well-illustrated with photos and dimensional drawings.

The author is experienced at metalworking with simple tools, and includes many helpful suggestions, such as how to make a metal-cutting tool out of a piece of scrap metal. See also Ole Wik's other book **Wood Stoves: How to Make and Use Them**.

The Complete Book of Heating with Wood, MF 20-439, book, 123 pages, by Larry Gay, 1974, Garden Way Publications, Schoolhouse Road, Pownal, Vermont 05261, USA; indefinitely out of stock.

The author covers many different aspects of heating with wood, concentrating on ways to burn wood efficiently. The chapters include information on choosing the proper type of fuelwood, log splitting, cutting enough wood without destroying forests, woodlot management, efficient stove designs, tips on ventilation, and using heat exchangers in the chimney to heat water. There are quite a few drawings of stoves, intended as ideas and not detailed designs.

Some parts of the book are aimed at American users, such as a section on choosing fuelwood that includes North American trees and climate considerations.

Splitting Firewood, MF 20-477, book, l42 pages, by David Tresemer, 1981, $4.50 plus postage and handling from Ag Access, P.O. Box 2008, Davis, California 95617,

North Americans who split their own firewood for heating stoves will find this to be an interesting and entertaining book.

"As we shall see in the section on modern splitting tools, helves (or handles)

are made of several materials, including wood, steel, fiberglass, and new types of plastic-coated fiberglass. Comparing the performances of the different splitting devices makes it very clear what one wants in a handle .... The helve must be firm but not stiff in order to absorb the vibration of impact without jarring the hands and arms. That is, it must have resilience, defined as 'the amount of strain energy which can be stored in a structure without causing permanent damage to it.' I prefer to carry the attitude of the old woodsman who bragged he had used the same ax for fifty years. 'Really?' inquired the listener. 'Yep,' said the woodsman. 'And it's had five new handles and two new heads.' "

Based on the author's painstaking research, this volume covers the art of splitting firewood in detail, with excellent illustrations, useful charts, and interesting historical quotations. Topics include the selection, care, and use of tools; proper procedures and techniques: and the spiritual dimensions of splitting.

Less Smoky Rooms, MF 20-472, book, 104 pages, by Andreas Bachmann, 1984, UNICEF/Nepal, out of print.

A collection of chimney and stove ideas from Bhutan and Nepal fill this book. Most unusual are the cement chimney blocks, the back-draft protection devices for the tops of chimneys, the small metal room heaters, the wood-fired water heaters, and several cast-iron stoves. The other material is covered in more detail in other books by the same author.

Rice Husks as a Fuel, MF 20-456, book, 76 pages, by Craig Thorburn, P.T. Tekton Books, 1982, Volunteers in Asia, out of print.

Rice husks, usually regarded as a waste product of rice processing, can easily be used as a fuel for cooking or for firing bricks, tiles, or earthenware vessels, thus alleviating pressure upon rapidly diminishing sources of firewood. But burning unaided, rice husks smolder slowly, producing thick acrid smoke. This book documents 18 simple stoves and kilns developed by people in Indonesia, Thailand, and the Philippines to overcome these poor burning characteristics, and to take advantage of this plentiful and inexpensive fuel. Text in English and Indonesian with 60 illustrations.

Rice Husk Conversion to Energy, FAO Agricultural Services Bulletin No. 31, MF 20-455, book, 175 pages, by E. Beagle, 1979, $9.00 from UNIPUB.

This is an extensive reference book on the enormous variety of energy applications for rice husks around the world. About half of the world's 60 million tons of rice husks produced annually are currently used; another 20% (12 million tons) apparently could be used as well.

The author discusses the general processes for converting rice husks into energy along with existing technologies for doing this. Steam engines, producer-gas engines, paddy dryers, and domestic cooking stoves are among the topics considered. Where parboiling is done, small steam engines can effectively be used to power the mills and provide heat for parboiling. Where parboiling is not done, the best power choice for small (less than 5 tons per hour) mills would be "an engine fueled by gas produced from rice husk .... This system of 'producer gas' is of proven technology, having been in continuous use for over 75 years." The great range of technologies discussed is unfortunately not supported by enough drawings.

The format allows the reader to go on to find more detailed information when relevant. For example, it is noted that the standard rice mill in Thailand is driven by a rice hull fired steam engine. A 224-entry list of contacts includes makers of such equipment in Thailand, and the 264-entry bibliography leads to further information on a wide variety of other topics.

The author concludes that rice husks are used far more extensively as an energy source than is generally recognized, that manufacturing capabilities for the related equipment are greater than realized, and that difficulties in information exchange prevent wider progress in applications. This book is a major step in overcoming the information exchange problem.

Double Drum Sawdust Stove, Research Note #NE-208 and Photo Story #30 MF 20-444, leaflet, 7 pages, by J. Wartluft, 1975, Northeastern Forest Experiment Station, Ohio, $5.25 (overseas orders add $3.00 for surface mail, $5.00 for airmail) from VITA; also available in French and Spanish.

This is a brief description of experiments done with a sawdust burning stove which consists of an inner drum filled with packed sawdust, and an outer drum used to channel updrafts. Rice hulls could also be used as the fuel. Photos are included as well as a simple dimensional drawing of the original design (reproduced here). Installation and operation are also described.

These two papers are short but concise, providing enough information to enable someone to build a stove using this design. Although designed for space heating, this stove could be adapted for cooking as well.

Sawdust-Burning Space Heater Stove, MF 20-457, dimensional drawings with text, 9 pages, by D. Huntington, 1975, out of print.

This is a stove very similar to the one above, which can be used for heating or cooking. The plans are easy to understand. Welding facilities are recommended but not necessary for construction. The stove provides a steady heat output. Ideas are given for using the stove as the basis of a forced air heating system in colder climates, where it may be placed in a room apart from the area to be heated. Rice hulls can be used as the fuel.

Comparing Simple Charcoal Production Technologies for the Caribbean MF 20-466, book, 42 pages, by Jeffrey Wartluft and Stedford White, 1984, $8.75 in U.S., $9.00 international surface mail, $11.75 international air mail, from VITA.

Comparative testing of four charcoal kilns and retorts and a traditional Caribbean method revealed some interesting results. "The traditional Montserratian coal pits can provide yields of charcoal that are comparable to the yields from larger metal kilns and retorts, and are superior in yield to single-drum kilns." The traditional pits are also by far the least expensive technology, with lowest initial investment, longest equipment life, and least time investment per unit of charcoal produced. Construction details are provided for the pit system and for each of the other technologies.

This report and independent results from Thailand provide evidence that well-made and operated earth charcoal pits can be used to produce charcoal efficiently and at very low cost. This contradicts the general literature which portrays earth pits as quite inefficient.

The Development of the Subri Fosse Charcoal Kiln, paper, 28 pages, by J.M. Lejeune, FAO/Ghana, Field Document No. 28 Mom project GHA/74/013, 1983, available in microfiche form only from FAO.

This unusual charcoal kiln design was developed in a research project in Ghana, in an effort to minimize foreign exchange costs and total wood handling and labor costs. The application was in forest clearing operations, in which transportation was difficult and costly. Large fixed metal kilns resulted in high foreign exchange costs and high wood handling costs. Existing portable metal kiln designs also had high foreign exchange costs. The traditional earth pit/mound kilns could be constructed on the spot of use, but had high labor costs associated with covering the mounds with earth and sifting the charcoal from the top layer of dirt, which tended to collapse into the pit during or after firing.

The investigators came up with a compromise design that included an earth pit with loose steel sheets as a cover. This kiln could easily be moved from place to place, produced good quality charcoal at an economical price, and required only a relatively small amount of foreign exchange. The investigators solved the problem of the metal sheets being damaged by the charcoal by holding them in an arch with steel angle iron at each end; in this way they did not come into contact with the charcoal.

The Construction, Installation and Operation of an Improved Pit-Kiln for Charcoal Production, Rural Technology Guide 15, MF 20-481, booklet, 20 pages plus construction drawings, by A.R. Paddon, 1986, no charge for single copies sent to governmental and educational establishments, research institutions, and nonprofit organizations in countries eligible for British aid, available from NRI.

This is an improved traditional pit-kiln with portable metal sheets as a cover, very much like the Subri Fosse charcoal kiln. These instructions provide better construction details and contain clear photographs that illustrate each step in the process of building, loading, lighting, and unloading the kiln. The fabrication of the cover is very simple. A sieve chute for loading charcoal into bags is also presented.

Charcoal Production Using a Transportable Metal Kiln, Rural Technology Guide 12, MF 20-465, booklet, 18 pages, by A.R. Paddon and A.P. Harker, free to recipients of British aid, £1.00 to others, from NRI.

Photos and text show how to properly load and operate a lightweight sheet metal charcoal kiln that can be rolled from place to place. When properly operated, this kiln is more efficient than traditional pit systems. Production is 1/2 to 3/4 ton of charcoal per batch. With two kilns, two people can produce 2-3 tons of charcoal per week. Construction details for the kiln have been published separately as Rural Technology Guide 13, The Construction of a Transportable Charcoal Kiln (MF 20468, booklet, 19 pages, by W.D.J. Whitehead, 1980, same source).

Charcoal Making for Small Scale Enterprises: An Illustrated Training Manual, MF 20-438, 26 pages, International Labour Office, 1975, out of print.

This short, large-format booklet is a good source of details of correct operation for two kinds of low-cost charcoal making kilns (most common and virtually no-

cost) and small portable steel kilns (approximately $2000 each). "Earth kilns are simple to construct and operate, and produce good results when managed by experienced people."

The language is simple and there are many drawings and photos. Notes on the preparation of wood, tools required, calculation of production costs, marketing, and charcoal-making cooperatives are included. Unfortunately, there are no rules given for estimating efficiency of a kiln, nor is the end-use efficiency of charcoal vs. direct wood burning discussed.