



Russian Comfrey from the 1878 Farm Seeds Catalogue of Messrs. Sutton and Sons. The leaf shape is not quite accurate, but this is how the plant should look when two to three feet high before each of the eight cuts from April to November

RUSSIAN COMFREY

*A Hundred Tons an Acre of
Stock Feed or Compost
For
Farm, Garden or Smallholding*

*by
Lawrence D. Hills*

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by the same author

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THE PROPAGATION OF ALPINES

ALPINES WITHOUT A GARDEN

RAPID TOMATO RIPENING

{With E. H. Haywood}

I dedicate this book
to
the memory of
KENNETH CRAWLEY
of Lockerbie, Dumfriesshire,

HENRY DOUBLEDAY, F.R.S.
of Coggeshall, Essex,

and the other long-dead men
with faith in the crop

Preface

This book is the story of a plant that has grown almost as fast and as deeply into my life as it does on the land, and my first thanks are due to Mr. Gordon Saunders for the steadfast scepticism linked with willingness to try anything once, with which he began the experiments at his farm nursery at Southery. It was from this beginning that my quest began.

Those who have helped in the agricultural and botanical detective story of the past, the present and the future of this crop, fall into three main groups and perhaps the most valuable assistance of all has come from the modern Comfrey growers. Foremost and first, I have to thank Mr. E. V. Stephenson for the benefit of his fourteen years' experience of feeding the crop to race-horses, cattle, pigs and poultry, and for his photographs and the photographic and other facilities afforded me at his Little Weighton Stud. I am also indebted to Lady Eve Balfour and the Soil Association, Mrs. P. B. Greer, Mr. J. W. Hobbs of Fort William, and Messrs. Websters Nurseries for practical information on growing, conservation and yields. The assistance of Mr. J. C. Wylie, B.Sc, A.M.I.C.E., County Engineer to the Dumfries County Council, on composting with sewage sludge, his experimental results and his photographs are also much appreciated. The greatest debt can never be acknowledged to the late Kenneth Crawley of Lockerbie, Dumfries, but I wish to thank Mrs. Crawley, Mr. Leonard Crawley, Mrs. Elizabeth Elwes and Mr. E. P. Dunham for their efforts to pass on the surviving records of his researches in the 1940's. Grateful acknowledgments are also due to his farm workers who rallied in reply to a letter in their local paper, especially to Mr. Hugh Logan, farm foreman and to Mrs. Logan, who reared the turkey chicks on page 110). Henry Doubleday's men in the 1870's are long under the land they used to plough, but I would like to thank Mr. Thomas Doubleday of Coggeshall for the family history of the introducer of Russian Comfrey to Britain. With the men and women who know and grow this long-neglected crop, I would thank also the fanners and smallholders who prefer to be nameless; their addresses are available to serious research workers who wish to confirm yield figures and points of detail.

The second group of people whose kindness has made landmarks in a journey running back through 182 years of agricultural history, includes the Librarians of the Royal

Horticultural Society, the Royal Agricultural Society of England, the Royal College of Veterinary Surgeons, the Ministry of Agriculture and the public libraries of Hackney and Lewisham; the Editors of the *Dumfries and Galloway Standard*, the *Essex Guardian*, the *Lewisham Recorder*, the *Scottish Farmer* and the *Farmer and Stock-Breeder*; and on the medical side, Dr. Rowson of the Pharmaceutical Society of Great Britain.

The third and largest group of helpers are in no way responsible for my views on Comfrey; they have given generously of their time and technical knowledge in the interests of scientific accuracy. I wish to thank Professor Stephen J. Watson, M.Sc, D.Sc, F.R.I.C, for information on silage; Professor H. E. Woodman, M.A., Ph.D., D.Sc, for additional details of analysis to the figures in his *Rations for Livestock* (Bulletin 48), from which, by permission of the Controller of Her Majesty's Stationery Office, Tables 1, 2, and 3 are reproduced and calculated; Professor K. W. Braid, M.A., B.Sc, of the West of Scotland Agricultural College for his genetical chart and botanical information; and Dr. P. J. Watson for permission to reproduce her material on the genetical and cytological aspects in Appendix I. My thanks are due also to Dr. William Davis, D.Sc. of the Grassland Research Station for yield figures of fodder crops other than Comfrey; Mr. C. V. Dadd, M.A., N.D.A., of the National Agricultural Advisory Service, for advice and help spread over many years; Mr. W. Holmes, B.Sc, N.D.A., of the Hannah Dairy Research Institute, for supplementary information to his article in *Agriculture*, and to my father, Mr. W. D. Hills, B.Sc, F.G.S. for his microphotographs, Appendix III, and his mathematical checking of calculated figures. For information on Comfrey on the Continent I am indebted to Dr. Robert Zander of Berlin, and the Deutsche Landwirtschafts-Gesellschaft, to the Commonwealth Bureau of Pastures and Field Crops for a survey of information sources, and to the Harper Adams Agricultural College for some details of poultry husbandry. Technical assistance is acknowledged from Messrs. Pest Control on selective weed-killers; Messrs. Harry Ferguson Ltd. on mechanization, and Messrs. Hurst & Sons, wholesale seedsmen, for historical material.

Permission to reproduce published matter is gratefully acknowledged from Messrs. Sutton & Sons of Reading for the engraving of a Comfrey plant and the cultural directions from their 1878 Farm Seeds catalogue; to the Cambridge University Press and the authors of *Flora of the British Isles* for the botanical descriptions of the Symphyturns given in Appendix I; to Messrs. Faber & Faber and Miss Juliette de

Bairaclí Levy for Appendix II from *Herbal Handbook for Farm and Stable*; the *Dairy Farmer* for material on pigs in Chapter V, and to *Curtis's Botanical Magazine* and the Royal Horticultural Society for the reproduction of contemporary engravings.

Finally, I would like to express my thanks to my long-suffering voluntary typist, Miss P. M. Lyall, for her speed, her sympathy and her encouragement in my difficulties.

LAWRENCE D. HILLS

Southey, 1949

Barnet, 1953

Contents

| | |
|--|---------------|
| Preface | <i>page</i> 8 |
| I. Russian Comfrey and its History | 15 |
| II. Modern Comfrey Growers and Research Results | 42 |
| III. The Cultivation and Management of Comfrey | 59 |
| IV. Russian Comfrey for Grazing Animals | 85 |
| V. Russian Comfrey for Pigs and Poultry | 96 |
| VI. Russian Comfrey in the Garden | 114 |
| VII. Municipal Composting and Comfrey | 130 |
| VIII. The Future of Russian Comfrey | 137 |
| I. Botanical Descriptions and Genetics of the Comfreys | 145 |
| II. The Veterinary uses of Comfrey | 153 |
| III. Moisture Content of Green Crops | 155 |
| Bibliography | 158 |
| Index | 163 |

Illustrations

PLATES

| | |
|--|-----------------------|
| 1. <i>Symphytum asperrimum</i> , the garden Prickly Comfrey | <i>facing page 20</i> |
| 2. <i>Symphytum officinale</i> , the Herbalist's Common Comfrey | 21 |
| 3. <i>Symphytum tuberosum</i> , the wild Tuberous Comfrey | 28 |
| 4. <i>Symphytum peregrinum</i> , the agricultural Russian Comfrey | 29 |
| 5. Russian Comfrey plant ready for a 10 lb. cut | 48 |
| 6. Trial row of Comfrey, Southery 1950 | 48 |
| 7. Comfrey ruined by grass and close grazing | 49 |
| 8. Comfrey weeded by semi-intensive poultry | 64 |
| 9. Neglected Comfrey on good land | 65 |
| 10. Neglected Comfrey on poor land | 96 |
| 11. A daily ration for mares and foals is appreciated | 97 |
| 12. Phideas, famous stud stallion, enjoys his Comfrey | 97 |
| 13. Microphotograph of stiff leaf bristles | 112 |
| 14. Microphotograph of wilted leaf bristles | 112 |
| 15. Weeding poultry in action | 113 |
| 16. Cutting by hand pays on plots too small for tractors | 132 |
| 17. Loading compost at Dumfries Corporation Sewage Works | 133 |
| 18. Young Comfrey plant grown indoors | 140 |
| 19. Microphotograph of a young Comfrey leaf | 141 |
| 20. The unknown crystals in a drop of bristle fluid | 141 |

TEXT FIGURES

| | |
|--|---------------------|
| Russian Comfrey from Sutton's 1878 Catalogue | <i>frontispiece</i> |
| 1. <i>Symphytum tuberosum</i> from Gerard's 'Herbal' | 22 |
| 2. Russian Comfrey in flower | 30 |
| 3. Russian Comfrey kept cut, 9 ft. in circumference | 32 |
| 4. Chart of the genetical relationships of Comfreys | 38 |
| 5. Leaf bristle, highly magnified | 77 |
| 6. Crown and root cutting, natural size | 125 |

TABLES

| | |
|--|-----|
| 1. Comparative analysis of Comfrey and other fodder crops | 53 |
| 2. Wilted analysis of Russian Comfrey | 53 |
| 3. Yields in lb. per acre of nutritional substances | 56 |
| 4. The drying curve of grass and fodder crops | 156 |

CHAPTER I

Russian Comfrey and its History

Russian Comfrey is a perennial fodder crop, in the lucerne class for nutritional value but with a vastly greater yield. This yield, in from six to eight cuts between early April and the end of November, totals forty tons an acre for a poor crop, and a hundred tons for a good one. It is a member of the order *Boraginaceae* and therefore avoids the galaxy of viruses and eelworms that beset so many modern crops. Its high average protein of 24 per cent of the dry matter, and low average fibre at 10 per cent when cut at the leafy stage, makes it ideally suited for pigs and poultry.

'Russian Comfrey is a weed; no stock will eat it; its yield in dry matter per acre is below that of orthodox fodder crops; it is impossible to get rid of, and fit only for a half-hearted trial on an odd corner of land where nothing else will grow. Its possibilities have been greatly overrated by those who sell it at high prices, and nothing reliable is known about it. . . .'

For over a hundred and fifty years these opinions, in conflict favourable and unfavourable views, have kept this plant a flying saucer of agriculture, briefly sighted still in the correspondence columns of the farming press. Yet hidden in the recurring controversy lies a crop that could lift Britain out of her chronic high-grade protein shortage. Meat, butter, milk, and eggs all demand more space on the land to grow the feed that produces them than do crops for direct human consumption, which are up to ten times as efficient in terms of mouths fed per acre. We have only one-third of an acre of fertile land for every one of our fifty million people, and roughly 150,000 'thirds' a year go under homes, roads, playing fields and factories. It is only by increasing production from the 'thirds' available for crops (and bringing less fertile land into cultivation) that we can continue to eat, especially when countries overseas, including our Colonies and Dominions, do not wish to exchange the produce of their acres for the goods we have to offer.

New knowledge and changing economic conditions have brought many old processes back into use and justified modern research in following long-abandoned experiments to successful conclusions in many far smaller and less important industries than Agriculture, with its £700 millions a year of food production. Russian Comfrey well merits such research, for it may have the most rapid growth speed of any plant that will grow in a temperate climate; and as a means

of making the sun and the land work harder, it deserves the same searching examination that modern science would give to a new type of lipstick or a faster passenger aircraft that could be exchanged for beef and bacon by the Road to Roundabout of international and Empire trade.

It is the purpose of this book to clear the myth and mystery from a fodder crop whose yield, with good husbandry, far outweighs its disadvantages, for the general farmer, the pig and poultry farmer, the small-holder, and the amateur gardener and poultry-keeper.

The agricultural and botanical detective story of the chase is only of incidental interest, but the extreme difficulty of obtaining any accurate information on growing and feeding explains one of the crop's handicaps. Had lucerne faced the same problem, it would be unknown on British farms to-day, and had the research that led to the discovery of the need for its inoculation never been undertaken, the analogy would be exact. There has never been a Rothamsted Comfrey Conference, and the small plot once grown there was ploughed up and scorned as a weed, before any serious trial of its yields by different methods of cultivation were made.

The story of Russian Comfrey begins in 1771. In this year Joseph Busch, a nurseryman and landscape gardener of Well Street, Hackney, E.8, sold his business (which now has an L.P.T.B. garage on its site) to Conrade Loddige, another rising nurseryman. With the casual internationalism of the larger but freer world of horses and sailing ships, he had taken a job as head gardener to the Palace of St. Petersburg for the Empress Catherine II (The Great) of Russia. From his new job, some time between 1790 and 1801, he sent back several *Symphytums* as garden plants, relations of the wild *S. officinale*, the Common Comfrey, with which they unfortunately shared the habit of having thirty-six chromosomes in each cell (See *Chromosome Atlas of Cultivated Plants* by C. D. Darlington and Dr. E. K. Janaki Ammal. Allen & Unwin. 12s. 6d.)

Messrs. Loddige, now 'and Sons', had expanded greatly, buying from St. Thomas's Hospital the land that is now St. Thomas's Square and the much-bombed Loddiges Road, whose name commemorates this famous nursery. Though they were mainly cashing-in on the great days of British greenhouses with stove plants and orchids (they were importing orchids from Monte Video, Uruguay, in 1812, the year of Napoleon's retreat from Moscow), they grew a wide range of hardy subjects. These included 1,393 different species and hybrid roses and no fewer than seven *Symphytums*. The 16th edition of their catalogue, dated 1836,

is in the Hackney Public Library. Unfortunately this is not descriptive, but like many of the more dignified publications of this time, consists of names only, rather resembling a Kew hand-list.

The seven Symphytums included *S. asperrimum* Donn. (the last word is the abbreviated name of the botanist who first described it) which is illustrated facing page 929 of *Curtis's Botanical Magazine* for 1806. 'This species of Symphytum, a native of the Caucasus, is by far the largest of the Genus, growing to the height of five feet, an ornamental perennial which will thrive in any soil or situation.' Its flower-stem leaves are always opposite and its leaves and stems are not only hairy but covered with short, stiff bristles, hence its popular name of 'Prickly Comfrey', and its specific one of *asperrimum* or 'the roughest'. Its flowers were vivid blue and both the illustration in Curtis and plate 77 (both in colour) of *The Ladies' Flower Garden* by John Claudius Loudon (vol. 2 of the 1844 edition), show not only its beauty, but the skill of the engraver. When grown uncut it flowered freely and did not produce the weight of foliage that gives it agricultural value, though it must have been on the powerful side in the well-manured herbaceous border. *The Dictionary of Gardening* (Royal Horticultural Society, 1952, 4 vols. 10 gns.) still recommends it as a plant for the wild garden.

Another nurseryman, near Lewisham, was the first to discover the agricultural possibilities of the plant. James Grant, of whose catalogues and history not a trace remains, claimed yields of from forty to sixty tons an acre in from five to six cuts a year. On good land it grew up to seven feet high, but the weight was obtained by constant cutting, using the growth pressure of the great roots, like those of a dock but larger and stronger (for they drive up to eight feet into the ground) to secure growth speed, as the velocity of water is increased by a thumb over the tap. The simile is rough, for the roots were alive and stimulated by the cutting.

The first available reference to James Grant and his crop, which was launched about 1810, is in *The Encyclopaedia of Agriculture*, an earlier work (1825) by John C. Loudon, the Scottish botanist and writer (1782-1843). Since that date all agriculturally cultivated Comfrey has been called *Symphytum asperrimum*, though Mr. C. Bucknell, in a paper read to the Linnean Society on 19th June 1913, dealing with the Nomenclature of the Symphytums, re-christened James Busch's introduction *S. asperum*, and the R.H.S. Dictionary adopts this new name officially. As this book is concerned with agriculture, and not botany or horticulture, the change will be ignored, because the synonym has been used for 150

years and in the circumstances it would cause confusion, for every available reference in farming literature uses the old name. Botanical descriptions of this and all other species of *Symphytum* concerned will be found in Appendix I.

The plant slowly found its way into the many general works on agriculture published in the middle years of the nineteenth century. David Low's Dictionary in 1836 and Martin Doyle in *A Cyclopaedia of Practical Husbandry* in 1843, both endeavour to identify it with the 'Trottel' described by Arthur Young in his *The Farmer's Callender* in 1822. As this mysterious tuberous-rooted vegetable, imported from Labrador and grown by James Sibbald, Esq. of Paisley and a nurseryman at Greenock, turned yellow inside when cooked, and those of *Symphytum asperrimum* do not, but stay white like a potato and taste rather like parsnips, the 'Trottel' (whatever it was) can be safely removed from the confused history of the Comfreys.

Perhaps the best early account is found in *The Rural Cyclopaedia, Or a General Dictionary of Agriculture* edited by the Rev. J. M. Wilson (1847), which ran into many editions. He quoted the first cut-by-cut yield figures from Ireland, into which country the crop was introduced by the Bishop of Kildare and a Dr. Derenzy. The Rev. Henry More, at Carnew Castle in 1835, recorded 28½ tons an acre on April 28th, 31 tons in mid-July, and 22½ tons in mid-September. He recommends planting 15 inches apart and 2 feet between the rows, but gives no details of the spacing or manurial treatment used to secure the Castle Carnew yield. A small hybrid that appeared in 1825 is mentioned as unsuitable for agriculture.

John C. Martin, who edited *A Cyclopaedia of Agriculture* in 1856, states that though our native *Symphytum officinale* was grown as a fodder crop for its succulent shoots produced in early spring, of greater value than the unimproved pre-'early bite' grasses of the time, it was falling into disuse in favour of two exotic species, *S. asperrimum*, and *S. echinatum*, which gave heavier yields. However, *Morton's Encyclopaedia of Agriculture*, published about this date in two volumes, describes *Symphytum officinale* only, attributing to it the qualities of the Prickly Comfrey, a mistaken attribution taken over by many later writers.

The native species, as its specific name of '*officinale*' or 'of the (Herbalist's) shop' denotes, was of considerable value in medicine. The earliest description in Turner's *Herball* (1568) includes the following passage: 'The rootes are goode if they be broken and dronken for them that spitte bloode and are

bursten, the same layde to are goode to glewe together freshe woundes.'

Gerard, in his better-known *Herball* first published in 1597, is more detailed in his account 'Of Comfrey or Great Consound', and the following extract is quoted from the 1633 edition in the R.H.S. Lindley Library: 'The Great Comfrey hath rough hairy stalks and long rough leaves much like the garden Buglosse but greater and blacker (darker green), the floures be round and hollow like little bells of a white colour, the roote is black without and white within and very slimey. This differeth in no way from the former *{Symphytum officinale* var. *patens*) but onely in the colour of the floure which is yellowish when the other is reddish or purple' . . . Comfrey joyeth in watery ditches, in fat and fruiteful meadows, they grow all in my garden. . . . The rootes of Comfrey stamped and the juice drunke with wine helpeth those that spit blood and healeth all inward woundes and burstings.' Master Gerard was prescribing an 0.06 per cent dose of diureide of glyoxylic acid called 'Allantoin' to-day. This is present in both the roots and leaves of this plant, and the agricultural species, and its value as a cell-proliferant in making the edges of wounds grow together, healing sores, and internally for gastric and duodenal ulcers and intestinal irritations causing diarrhoea, is still recognized in pharmacy. A full account is given in *Squire's Companion to the British Pharmacopaedia* (1916) and the recommended strength for external application on lint changed three or four times a day of 0.04 per cent to 0.05 per cent is near enough to the natural 0.06 per cent to 'glewe together freshe woundes' for Master Turner's patients' safety, apart from the risk of bacterial infection.

In the circumstances, with no antiseptics, no anaesthetics, no possibility of successful surgery, and with knowledge of the workings of the human body based largely on theory, Master Gerard's prescription, in wine with enough alcohol content to sterilize it, probably gave his patient the best possible chance of surviving an 'internal bursting'. If this were acute appendicitis or peritonitis, the chance would be very slim but, as in Pepys's day when a 'swift colic' was a similar killing disease, the 'bursting' covered a wide range of internal complaints.

The justification for the name 'Symphytum' from the Greek of Dioscorides, *Syumphuo*, best translated 'to make grow together', is found in the pigman's tradition that Comfrey cures scour, and the modern Comfrey growers' opinion that it prevents and cures intestinal and digestive troubles in pigs, cattle and horses; and it can still be found

among the thronging 'mycins' of modern medicine. The most recent reference to Allantoin is in the 23rd edition of *The Extra Pharmacopaedia* (Pharmaceutical Press, 1952).

In *Veterinary Pharmacology, Materia Medica and Therapeutics* by Howard J. Milks, D.V.M. (Baillière, Tindall & Cox, 1949), Allantoin is described from the standpoint of animal medicine. It is a white crystalline powder which dissolves slowly in cold water but easily in hot, and with



1. *Symphytum asperum* Donn. From *Curtis's Botanical Magazine*, 1806. The bright blue-flowered border plant sent from St. Petersburg by Joseph Busch, introduced into horticulture by Conrade Loddige & Sons about 1801 and to agriculture by James Grant, 1810. Yields 40-60 tons or less an acre. Now officially *S. asperum* Lebech.



2. *Symphytum officinale* Linn. The British native valued by herbalists for its bone-knitting and healing qualities. The flower is cream, yellow or white, and there is a dark purple form. *S. officinale* var. *patens*. Note the distinctive extensions of the leaves down the stem called 'Wings'.

thicker skins, external applications can go up to 2 per cent. It can now be made synthetically instead of being extracted from the dried roots or leaves by herbalists, but is not greatly used, as more effective remedies are known. As it is present in the urine of many animals, it is of importance in some clinical tests. Robinson in 1935 isolated this substance in the excretions of maggots in plaster-cast-treated fractures, explaining why these infestations meant quicker healing and better knitting of broken bones, especially where osteomyelitis had delayed recovery. That is why this plant

that 'joyeth in watery ditches' still numbers 'Knitbone' among its country names. It could naturally set a bone crooked just as easily, but must in the past have saved many limbs with compound fractures or complications.

A modern account of its value in veterinary surgery is quoted in Appendix II in *Herbal Handbook for Farm and Stable* by Juliette de Bairacli Levy (Faber & Faber. 18s. 1952). However, as the medical emergencies in which it is of use are serious, it should not be regarded as an addition to the 'Nature Cure' medicine cupboard. Master Gerard wrote to pass on the knowledge of a trusty long-bow among the few weapons he had in the war against disease; to-day a vast armoury is available, including swifter and safer assistance for those that 'Spitte bloode and are bursten'.

As Gerard says, we have one other native Comfrey, rare except in Scotland, 'with floures of an overworne yellow colour. The rootes are thicke, shorte, black without and tuberous, which, in the figure are not expressed so large and knobby as they ought to be.' This is *S. tuberosum*, possibly the 'Trottel', which grows only 9 inches to 21 inches high, a smaller plant of no agricultural or medicinal value, with 72 chromosomes, a number which luckily keeps it out of the Comfrey confusion. Gerard's warning against his own illustrator is as characteristic of his age as his language. These 'Doctors of Medicine' in the Kipling sense of the term were far more careful to identify the right plant than many modern herbal writers; they knew that lives depended on their accuracy.

Symphytum officinale with cream, white or yellow flowers, and its variety *S. officinale* var. *patens* with purple, varying in height from one to four feet, will be found pure along the North Downs and in many parts of southern England, but are rarer in the north. Broadly speaking, they have paler green foliage, a higher fibre content, and lesser growth speed; even with increased vigour from good manurial treatment and cultivation, they cannot compare with the imported species.

The flowers of the Symphytums are peculiar in having the stamens covered with a kind of false bottom impassable to honey thieves, made up of five awl-shaped growths that thrust in from the sides of the corolla; but this false bottom can be thrust aside by the humble-bee that alone can fertilize the flower. This device seems at its most obstructive in *S. asperrimum*, and other bees bite a hole in the side of the flower to reach the honey. The difficulty of the process means that seed is rarely set: *S. officinale* is by far the easiest and produces the most, but even when seed is obtained it is slow

3 ‡ *Symphytum tuberosum*.
Comfrey with the knobby root.



grow vpon the stalkes are long, broad, rough, and
pricking withall, something hairie, and being

Fig. 1

Symphytum tuberosum from Gerard's Herball (1597) with roots
'expreffed' insufficiently black and knobby

to germinate and takes years to produce a crop; so that the agricultural Comfreys have always been increased by division or root cuttings.

The major long-term handicap has been cutting off the race from the selection and breeding skill of farm seedsmen, who have contributed greatly to the doubled wheat yields, since Joseph Busch sailed for Russia, by their development of new varieties. The sugar-beet originated in a seashore weed, and it is only by the 'roguing' of our seed raisers that many

crops remain productive. It was, however, the immediate effects of this difficulty that decided the future of the Comfrey.

No other farm crop is propagated vegetatively (grafted fruit trees do not concern the general farm) and the tubers of the potato are about the most costly 'seed' per acre on the farm. Increasing Symphytums by division multiplies them rather less rapidly than Michaelmas daisies, and though plants raised from root cuttings are very much easier and cheaper to produce than oriental poppies, Japanese anemones, and the border phloxes in a nursery, the cost is still high.

Therefore the crop was 'oversold', like 'Soil Conditioners' in the United States in the 1950's, and because the cost of planting an acre was so high (12s. per 100, £5 per 1,000 in 1878 from Sutton's; James Grant's price is unknown) its good qualities had to be magnified. The very minimum of practical information on cultivation or overcoming its disadvantages was given, to avoid the impression that it was a complicated crop to grow, for farmers will only tackle complications that they understand. An honest account of the problems and difficulties of making hay would prevent any conservative farmer from tackling the crop, were grass 'new-fangled' and expensive. Comfrey was recommended for every type of soil, and it was claimed that its great yields could be achieved where nothing else would grow, without manuring.

In justification for James Grant and other early nurserymen, it should be said that the knowledge of plant metabolism and soil fertility available at the time was limited. Rothamsted, founded in 1841, was far too preoccupied with measuring the results of artificial fertilizer applications, crop rotations, and the value of legumes; serious agricultural experimenters had too many exciting applications of new discoveries to try to have much time for a new crop, sold expensively by nurserymen, and gathering a bad reputation.

The high price meant buying small quantities for trial, and on any farm it is the small odd plot that is most easily ruined by neglect; it failed from nitrogen starvation on poor soils, and from the same cause where grass and weeds in the neglected crop produced the locking up of nitrogen, of value to fruit in the grassed-down orchard. Wherever it failed, it remained as a weed, because it is tenacious of life, and struggles on, starved out of all resemblance to the towering fountain of leaves achieved by good husbandry. The high price also accounts for the quite extraordinary number of clergymen in the history of Comfrey. The country parson,

with his glebe land, his horse, and his Gilbert-White-like interest in Nature and the Useful Arts, was the most frequent buyer.

Finally, both clergy and farmers began to collect *Symphytum officinale* which, as has been observed, will increase its yield with cultivation. This saved money and is largely responsible for the hybrids, with *S. asperrimum* as the pollen parent, which are found in many districts more commonly than the true plant known to Gerard. (See *Handbook of the British Flora* by George Bentham and Sir J. D. Hooker, any edition.)

Attempts were made to secure seed by artificial pollination but, according to Thomas Christy, F.L.S., in his *Forage Crops* (1876), with little success except where the wild Borage, *Borago officinalis*, supplied the pollen. This seed was sold and germinated, but the plants raised 'did not contain the mucilaginous and other properties of the true Caucasian Comfrey, and the result is seen in different parts of the country in a variety of Comfrey having smaller foliage, paler leaves, and lilac or cream-coloured flowers'. It is just possible that the bi-generic cross came off between the 36-chromosome *Symphytum asperrimum* and the 16-chromosome *Borago officinalis*; after all, the original cross-fertilizations between species that gave us the ancestors of the modern border Iris *I. germanica* were made in equal defiance of the then-unknown laws of genetics. Even as sterile mules the plants would persist as roots, repropagated constantly by the despairing hoeings and ploughings of the farmer, perhaps passing on pollen for further back-crosses with the wild species.

The result of this confusion is seen in letters to (among other periodicals), the *Gardeners' Chronicle*, the earliest from their first 'Constant Reader', in the 17th issue of their first volume, dated 24th April 1841. These alternate through the 1840's, 1850's, and 1860's, with a peak in the 70's and 80's, in a regular pattern. First a reader inquires about the crop, or gives a glowing account of it; then others rush in to tell him that it is a weed and utterly useless. It is referred to variously as *S. asperrimum* and *S. officinale*, and even the most enthusiastic give few details of how it has been grown, or what exactly has been cultivated. The plant itself is blamed for bad crops and praised for good, very much as Kale would be if no distinction were made between the Brassicas and the wild Charlock, with which they share a chromosome number of 18, and if no accurate knowledge existed of the turnip fly.

The following extracts are representative of over a hundred of both types appearing in the *Gardeners' Chronicle* then incorporated with the *Agricultural Gazette*, and other periodicals of this period.

Gardeners' Chronicle, 1st February 1845: 'Cattle will not eat it if they can get anything better, it must be eaten quite young. The plant does not deserve the attention it once excited.'

Gardeners' Chronicle, 31 st March 1866: '*Symphytum asperrimum*, the Prickly Comfrey. Some years since we cultivated this to some extent as a soiling (stall-feeding) crop for cows, and we must say that these animals will eat it greedily and it seems very useful. Its crop is large in May and June; when cut down it speedily throws up a second crop of succulent stems and leaves, but it must be consumed green as no creature could eat so rough a plant in a dry state.'

It seems far more likely to anyone who undertakes the research of reading all these letters (see the Bibliography for a selection of sources) that variations in the plant, and in methods of growing and feeding it, account for the complete contradictions expressed by this great number of farmers, clergy, and private citizens with no commercial interest in selling the plant, than that our ancestors were inaccurate observers or liars.

In the 1870's and 1880's Comfrey enjoyed a wave of popularity mainly through the work of four men whose experiments and writings form part of our basic modern knowledge of the crop. The most famous of the four was not a Comfrey grower, he was Dr. Auguste Voelcker, D.Sc, F.R.S., Consulting Agricultural Chemist to the Royal Agricultural Society of England. His article in the *Journal* of that body (1871, Vol. 7, second series, pages 387-9) entitled 'On the Composition and Nutritive Value of the Prickly Comfrey (*Symphytum asperrimum*)', gave a very good account of it, including the Carnew Castle yields. Even more important, it contains the first analysis ever made of *Symphytum asperrimum*, from plants grown in Oxfordshire, which he carried out in 1869. Part of the weight given to this article arose from the position held by Dr. Voelcker, which involved his testing on behalf of members of the Society samples of 'portable manures' such as Peruvian guano and mixtures endeavouring to cash in on the new artificial fertilizer market and concentrated feeding-stuffs. Many of these commodities were valueless, often fraudulent, and in issues of the *Journal* and by letter, the doctor exposed fraud to the pitiless technique of chemical analysis. Comfrey, however, was not condemned by the verdict.

The general analysis, stems and leaves together, was as follows:

| | <i>In Natural State</i> | <i>Calculated Dry</i> |
|---|-------------------------|-----------------------|
| Water | 90.66 | |
| Nitrogenous organic compounds (flesh-forming matter) | 2.72 | 29.12 |
| Non-nitrogenous compounds (heat- and fat-producing matter) | 4.78 | 51.28 |
| Mineral matter (ash) | 1.84 | 19.60 |
| | 100.00 | 100.00 |

Dr. Voelcker stated that 'the juice of this plant is very mucilaginous, though it contains but little sugar . . . notwithstanding the large amount of water the proportion of albuminous compounds (flesh-forming matters) in Comfrey is considerable, and the percentage of cellular fibre is not larger than in similar green food.

'In comparison with other similar food, I may state that Comfrey has about the same feeding value as green mustard, or mangold or turnip tops, or Italian ryegrass grown on irrigated land.'

The last sentence has been quoted for the past eighty years in books on forage crops, and the analysis frequently appears, complete with remarks on albuminous, mucilaginous and flesh-forming matters. These were the proteins, which are complex gummy substances, and of those gelatin was the first to be isolated, with albumen, in white of egg and fish, soon to follow. Gelatin was not then known to be indigestible; the measurement of digestibility was a further refinement of technique, and from this quick start, the custom of giving jellies as invalid food, and testing the quality of a soup from its forming a jelly when cold, survive as errors from these early days.

An even more valuable analysis was supplied to Messrs. Hurst & Sons, the farm and wholesale seedsmen, by Dr. Voelcker, and was fortunately preserved in their records which escaped the East End Blitz of 1940. It is also quoted in *A Modern Herball* by M. Grieve (Jonathan Cape, 1931).

| | <i>Leaves</i> | | <i>Stems</i> | |
|---|-------------------------|-----------------------|-------------------------|-----------------------|
| | <i>In Natural State</i> | <i>Calculated Dry</i> | <i>In Natural State</i> | <i>Calculated Dry</i> |
| Water | 88.400 | | 94.74 | |
| Flesh-forming Substances | 2.712 | 23.37 | 0.69 | 13.06 |
| Non-Nitrogenized substances, heat- and fat-forming | 6.898 | 59.49 | 3.81 | 72.49 |
| Inorganic matters (ash) | 1.990 | 17.14 | 0.76 | 14.45 |
| | 100.000 | 100.000 | 100.00 | 100.00 |

This is the only analysis we have in which the leaves and stems were treated separately, and they reveal, what is common knowledge in these days of ley farming and grassland research, that the best nutritional harvest is in the leaf. Wide variations in Comfrey analysis depend on the stage and quality of the cut; there is less water and more protein to lower fibre in a crop cut at the leafy stage, as well as more total weight each season than where it is allowed to run to stem and flower: a fact which also affects palatability.

The first analysis (the modern comparative analysis tables in the next chapter may well sound a little old-fashioned in another eighty years) confirmed what has never been doubted since, the high nutritive value of Comfrey. What has been doubted, not to put this more strongly, is its yield. Unlike grain or roots, even hay or straw which are weighed if sold off the farm, a fodder crop eaten by one's own stock is rarely measured. This type of measurement is made only by research stations and farm institutes, and these have very rarely carried out any work on the crop, and figures are quoted from textbook to textbook. In general, estimates before the 1870's give from 40-60 tons an acre; the greater the number of cuts quoted, the higher the estimated yield, with the Rev. Henry More's as the record.

From 1875 onwards we come to yields of 100 to 120 tons. They spring from Henry Doubleday of Coggeshall, Essex, a small farmer but a great experimenter, who imported from St. Petersburg what is either *Symphytum peregrinum* Ledeb., which grows 4,000 feet above sea-level near Sawunt in the Talsch Province of the Caucasus (pre U.S.S.R. names), or a hybrid of *S. officinale* and *S. asperrimum* known as '*S.X. uplandicum*'. There is no doubt that this is the plant illustrated facing page 6466 of *Curtis's Botanical Magazine* for 1879, for it is stated to be drawn and coloured from the plants presented to Kew in 1875 by Thomas Christy. He was a writer, a botanist, and a nurseryman living in Sydenham, who was greatly interested in the introduction of new plants, a Fellow of the Linnean Society, and a great friend of Mr. Doubleday's. Between them they began the boom in Russian Comfrey, as they called the new plant to distinguish it from the earlier Prickly Comfrey, *S. asperrimum*. The two popular names are now applied at random, but then the distinction was clear, and so far as farming and Britain are concerned, the question of whether it is a larger and stronger species, or a hybrid with renewed vigour, is irrelevant.



3. *Symphytum tuberosum* Linn. The other native British species with creamy yellow flowers and black tuberous roots more like those of a dahlia than shown in this 1844 engraving. Of no agricultural value, producing no bulk of fodder and contains no healing Allantoin. Rare in Southern England, common in Scotland and the North.



4. *Symphytum peregrinum* Ledeb. From *Curtis's Botanical Magazine*, 1879. Drawn at Kew from Henry Doubleday's plants on the only official trial in history of this variety. This engraving appears also in the account in the Kew Annual report for 1879. Flowers magenta pink. Yields 80-120 tons an acre when established.

The new introduction had an even greater growth speed, reaching 6 feet 8 inches as a maximum when allowed to run to flower. These flowers were at first blue and changed colour to a magenta pink, and it is this colour that marks the blood of the high-yielding comfrees. There is a brief account of the plant in the *Kew Annual Report* for 1878; the following is an extract:

'In England it has been found very useful for winter fodder, as it forms large tufts of root leaves which start into growth early in the year and bear several cuttings. It is greedily eaten by animals which refuse ordinary Comfrey, the habit and appearance of which is not very dissimilar.' The rest of the account is taken up with unfavourable reports from India, Australia, Ceylon, and Singapore, where it had been tried with enthusiasm but little success. The *Report* for 1879 gives more accounts of failure in tropical countries and the verdict that 'Extended trials have shown that this plant, although possessing great merits as an early fodder crop in cool and temperate countries, is physically unadapted for cultivation in hot countries.'

Henry Doubleday, the introducer, was the son of a Quaker grocer, barred from the professions by the religious refusal to take an oath. Henry Doubleday of Epping, the famous entomologist who compiled the first Systemic list of the British Lepidoptera, was his cousin, and his brother Edward was the Curator of the Botanical Department of the British Museum. He was a man of wide, but commercially unsuccessful, interests; starting first a starch factory in Colchester which failed because of a dishonest manager, and then patenting a glue which was used by Messrs. de la Rue on the backs of the early postage stamps. An interruption to supplies of gum arabic through war in Egypt lost him the contract, and he retired to his small farm. He was a Fellow of the Royal Society, but he never used the letters as he could not afford the few guineas' annual subscription.

He bred and developed a long-outclassed potato, the 'Berkshire Kidney', which he sold to Messrs. Sutton of Reading, and selected from his imported *Symphytum peregrinum* 'Doubleday's Solid-Stemmed Comfrey'. Our wild *S. officinale* will also throw up solid-stemmed forms, and this variety, which still appears in stocks springing from his introduction, was not only more readily eaten by stock, it also marked the first time anyone has ever even selected a Comfrey as a means of improving the race, if only by picking the best plants for propagation.



Fig. 2

Russian Comfrey planted as a crown, February 1876 and allowed to run to flower. Drawn 31st July 1876 on Henry Doubleday's farm at Coggeshall. Height, 4 feet; circumference, 7 feet

Henry Doubleday's writings and books have long vanished in spring-cleanings and salvage drives, and not even his bronze medal and statuette of Prince Albert, awarded him for a design for Nottingham Lace at the 1851 Exhibition, remain. Fortunately he was a great writer to the papers, and passed on his results freely to Christy who wrote them up with enthusiasm.

He gives the following cut-by-cut record from fifty-four plants on a rod of ground:

1st Cut, April 30th. In lb. each plant. Total, 1 cwt. 3 qtrs. 22 lb. 10, 7¼, 7¼, 5¼, 5¼, 6, 4, 5, 6, 6, 6, 4½, 5¾, 5, 3¾, 4¼. 2¾. 3, 2¾, 3½, 3½, 5, 3½, 4, 3½, 2, 7¼, 3¼, 5¼, 4, 4, 3, 3½, 3, 3½, 2¼, 2½, 3¼, 4½, 4½, 7, 4½, 2½, 3, 2¼, 2½, 2, 1¾, 2½, 1¾, 2½, 1¾, 1¾, 2, 1¾. Average per plant, 4.08 lb.

Second Cut, June 16th. In lb. per plant. Total, 2 cwt., 2½ lb. 10½, 3½, 2½, 5¾, 5¾, 1½, 7½, 5½, 5½, 3½, 3, 4½, 2, 4¾,

2¾, 2¾, 11½, 5¾, 6¾, 1½, 2, 5¾, 4¾, 5½, 3, 2½, 2¼, 1¾, 3¼, 5¾, 6¾, 1½, 2, 5¼, 1, 3¼, 2½, 4¾, 3, 5, 3¾, 2½, 2½, 9, 4, 3¼, 2¼, 5¼, 4½, 6, 6, 6½, 8¾. Average per plant 4.2 lb.

For the two cuts this gives a yield of 31 tons 15 cwt. an acre; Henry Doubleday took six and though he did not weigh each single cut on this plot, his yield again multiplied by three shows 95 tons 5 cwt. for second-year plants, of a crop that is not at maximum production until the third year. His 10-lb. plant was 4 feet high and 4 feet in diameter, and Plate 5 shows a similar plant of the same weight grown by the author in 1950. Sixteen pounds is about the record cut for one on a farm, but the aim should be to maintain a high average for the whole season.

On a research station the outer rows and end plants would have been disregarded as 'guards' because these often vary beyond the average (in this case both the 10-lb. plant and a 1¾ lb. one are in these positions) and the weighings continued through the season for every cut. Mr. Doubleday was a small farmer like most Comfrey growers, and had no time for this daily task; he had to cut approximately 160 lb. per day for his three cows and his pony, and measuring even the yield off a perch (or rod or pole) gives us better evidence than is offered for the low yields often claimed. He grew his strain for many years, and in his letters to the papers including the *Gardeners' Chronicle* (24th October 1885) stated that he obtained from 100 to 120 tons an acre, in from six to eight cuts. Thomas Christy, who was after all selling the plant, unlike the Quaker smallholder who grew it, writes in *Forage Crops*: 'The Solid Stem Variety is far more palatable and in every way they have proved superior to anything grown in this country as Prickly Comfrey. On good land, Russian Comfrey is fully equal to giving 120 to 150 tons an acre from plants placed one yard apart each way.' This book, illustrated with a rather badly coloured frontispiece of an obvious *S. peregrinum*, had great influence on the cultivation of the crop, which he reinforced in his later works, *New Commercial Plants* in 1878, and *Ensilage* in 1883.

Another keen Comfrey grower was Kinard B. Edwards of Burbage Hall, Hinchley, Leics. He was perhaps the first popular writer of little books designed to help the townsman turned countryman, and also the 'thrifty cottager'. These were published at 6d. each and privately printed, so most have vanished; none is in the British Museum, and one is in the Bodleian Library, Oxford.

In his 'An Acre of Land and How to Make the Most of It' (1873), he gives clear directions for the cultivation of the

plant as a 'soiling crop' for stall-fed cows, stressing the importance of keeping the land clean and well manured, and



FIG. 3

Russian Comfrey ready for the third cut, height, 3 feet; circumference, 9 feet; growing on good Essex clay in the plot that supplied the plants tested at Kew. Planted February 1876, drawn July 1876

with adequate cutting. He gives yields of 10 to 15 tons per acre per cut; totals of 50 tons the first year, 80 the second and after that 100 to 120 tons. For the other crops mentioned in this work, yields such as 40 tons an acre for mangolds are normal on good land to-day. In his 'The Amateur's and Cottager's Cow', date about 1875, he quotes a neighbour of his who has fed three cows and two horses off the produce of a quarter of an acre of Comfrey, and gives a normal annual yield of 80 to 90 tons.

Several seedsmen took up the distribution of the plant, and some endeavoured to get over the problem of cost by selling small root cuttings cheaply, but their slow rate of growth the first year and the handicap of weed competition at this stage, produced very poor results. The Frontispiece is from the Catalogue of Messrs. Suttons of Reading for 1878, probably *Symphytum peregrinum*, and it gives a far better idea of how the plant should look on the farm than a botanical drawing showing the flower stem, which is like illustrating celery or sugar-beet with their 'bolters'.

They give a very good account of the plant; the holes filled with rotted dung would make absolutely sure that however bad the soil, the customer would get a crop and establish his plants, even on soils of a superlatively 'dry and sandy nature'. Their description runs:

'This forage plant, introduced into this country a few years since, is rapidly increasing in favour. Although we do not agree with all that has been said in its praise, yet we believe it to be a valuable plant for giving a supply of green food in hot dry seasons. The long roots, which penetrate a great distance into the ground, enable it to obtain moisture beyond the reach of ordinary plants. It will succeed in almost any soil but is especially valuable when cultivated on soils of a dry and sandy nature. It is very hardy and gives an early cutting, supplies a constant succession of green food, and, when once planted, is permanent. It is much relished by all kinds of stock, either cut up and mixed with chaff or separately. For milch cows it is most valuable and it is much relished by domestic poultry. It is cultivated by dividing the roots and spring and autumn are the best seasons for planting. Holes should be dug 24 to 30 inches apart each way and filled with well-rotted stable dung. The cuttings should then be deposited and covered over with earth, leaving the crowns 1½ to 2 inches under ground. It is very important to keep the ground clean and free from weeds. When the leaves have grown from 18 to 24 inches high, they should be cut and given to the stock in a fresh green condition. In about six weeks, a second cutting will be ready and a succession of cuttings can be obtained through the summer and autumn. As many as five heavy cuttings, each 20 tons per acre, or 100 tons per acre in one season, have been obtained by good management. If it is cultivated for one or two heavy cuttings, the stems should be allowed to grow to 4 or 5 feet and it may be cut with an ordinary hook, tied up in bundles and conveyed to the homestead as required. We recommend it especially for small occupations, as few crops can be more easily grown or prove so useful to those whose livestock consists of a horse, cow, and a few pigs.'

This account, far fuller and clearer than those which will be found in almost every 'Farming Dictionary' between 1840 and 1900, gives the main principles of Comfrey growing, without stressing its problems, and the farming press of the time is filled with articles and letters not only from Comfrey sellers, but their satisfied (and dissatisfied) customers.

The Rev. E. Highton of Bude bought 200 plants from Messrs. Sutton in 1875 (they sold it between 1875 and 1896) carried out the 'directions on the packet' to the letter, and cut

at the rate of 60 tons an acre the year of planting. He then dug his plants up and kept increasing them till he had a quarter of an acre, maintaining his yield all the time. He reports that house cows and pigs thrive on it; by feeding it *ad lib.* to his horses, he reduced the oats ration from 6 to 3 quarts a day without loss of condition.

His report appears in the article on 'Green and Fodder Crops not Commonly Grown that Have Been Found Suitable for Stall Feeding' by Joseph Darby (*Journal of the R.A.S.E.*, Vol. 18, 1882) which includes a large selection of letters of opinion on the crop, including Henry Doubleday's statement that it yields 120 tons an acre for four to five cuts a season, and lasts twenty years if the land is kept clean and occasionally stirred. T. R. Hulbert, Esq. of North Cerney regarded it as a delusion; 'it needs very good land, plenty of dung and attention, and no stock will eat it if they can get other food.' A Mr. Sewell-Read considered the plants tiresome to cut, costly to collect, and expensive to buy. Both Sir Thomas Acland and Lord Morden considered it a useful crop, and the Rev. F. Gilbert White (of Ashburton, not Selborne) considered it splendid fed chaffed with hay, and producing very high-quality butter. It did not taint or cause hove (bloat). No correspondent gave any flower colour, and most are too brief and optimistic (or pessimistic) to give details of how it was grown. In the many articles of this nature which appeared at this period it will be noted that those who grazed it as distinct from feeding it wilted (as Christy and Doubleday recommend) refer to 'no stock eating it'; those who take three cuts a year give yields in the 40-50 ton region; those who cut most often have both the highest yields and opinions of the plant. David Wemyss of Newton Bank, St. Andrews, in 'The Cultivation of Prickly Comfrey and its Uses as a Fodder Plant' (*Transactions of the Highland and Agricultural Society of Scotland*, Vol. XIV, 1882) refers to the 'even better Solid-Stemmed Variety' and gives a yield of 100 to 120 tons of good fodder per acre per annum. He recommends feeding wilted until the stock are used to it, and cutting when half-grown; the plant should never be allowed to become hard and woody. He also stresses the richness of the butter.

The *Gardeners' Chronicle*, *The Country Gentleman's Magazine*, *The Field*, *The Times*, and the journals of all the agricultural societies printed a steady stream of letters, but not so much because of the interest among farmers. The development of 'portable manures' (artificial fertilizers), knowledge of crop rotations and the action of legumes, and the increasing agricultural depression were quite enough to swallow, without a new crop that was also expensive. The plant, as always, interested the letter-writing classes. It was

about this time that the most frequently quoted letter of all appeared in an Irish newspaper, stating that no beasts or sheep would eat Comfrey, detailing the ploughing, harrowing, hoeing, and finally picking up by hand into baskets unsuccessfully employed, and finishing with the plea 'Can you or any of your correspondents tell me how to get rid of it?'

Another problem of the crop was that while it provided a great bulk of fodder in spring and autumn, it was no help in the winter. Its bristly leaves were thought unsuitable for hay, and its thick stems hard to dry except in perfect weather. Thomas Christy's *Ensilage* on the new process advocated it strongly, and so did the following letter in *The Times* for 24th October 1882, from J. Bailey Denton, a famous authority on agriculture: 'Permit me to draw attention to this omission and thus indirectly to a valuable foreign forage plant (*Symphytum aspernum*) which affords four to five cuts a year, weighing as much in the aggregate as 100 tons an acre, which appears especially suited for the silo. In fact the extraordinary bulk of cattle food which may be gathered from it, would suggest its special growth as an ingredient of ensilage.'

Unfortunately, the methods of silage-making then known were particularly unsuited to Comfrey, a high protein and moisture crop relatively low in carbohydrates. To quote Professor Stephen J. Watson's *Silage* (Crosby Lockwood & Son, 1951): 'Then, in 1885, George Fry published his book, *Sweet Ensilage*, and this, more than anything else, sounded the death knell of silage for the time being, and the process was set back fifty years.' This process involved rapid heating, and like those used earlier did not introduce molasses. A crop which is naturally high in carbohydrates had the best chance of producing sufficient lactic acid to arrest decay by acidity; one higher in protein swamps this effect with the evil-smelling and complex by-products of their decay. Russian and Prickly Comfrey were the worst possible subjects for bad silage methods, and it is to this period that all reports of the poor quality and unpalatability of silage made from the crop can be traced. The few modern experiments, especially by the A.I.V. system, have been almost entirely successful. (See Chapter III.)

From this period Comfrey growing fell into decay. The 'Farmer's Notebooks', the 'Manuals', the 'Encyclopaedias' ran on by quotation, but with fields falling out of cultivation and agricultural depression, Russian Comfrey began to vanish. The famous plot at Carnew Castle with age and neglect died out into weeds that can still be found in the hedgerows. The cost of new planting became prohibitive with falling prices for

farm produce, and new topics filled the correspondence columns.

In 1900 Messrs. Webster's Nurseries of Stock, Essex, imported a fresh supply of *Symphytum peregrinum* from Russia and have continued to grow and sell this plant, as the 'James Grants' of the twentieth century. They rogued their stock by removing the least vigorous plants and selecting for division those which, when grown on the six cuts a year system, produced the characteristic two-foot leaves, between eight and ten inches across, dark green, and bristly on the undersides. The flower colour was magenta pink varying to purple, but not the dark and dingy colouring of *S. officinale* var. *patens*, and never including the clear bright blue of *S. asperrimum*, distributed by Messrs. Loddige and illustrated with such beauty in Curtis, London, and other authorities of the great days of flower portraiture.

In addition to the effect of the discarded results of unsuccessful plantings of the new species on the racial melting-pot of the hedge-banks, plus throw-outs from the herbaceous border such as *S. caucasicum*, a smaller blue-flowered *S. asperrimum* and *S. orientale* (which has soft hairs on its leaves rather than bristles), a further problem arose. The writings of Thomas Christy and Henry Double-day had given prestige to the name of 'Russian Comfrey', and therefore this name was used, together with the yield figures of the 1870's and 1880's, to sell whatever was being sold. Messrs. Webster in their catalogue, and almost everyone writing on the plant, used also the name *S. asperrimum*; the clear distinction drawn in Curtis's *Botanical Magazine* and the article earlier quoted from the *Journal* of the Linnean Society, of the name *S. peregrinum* for the heaviest-yielding species, vanished for over fifty years. Therefore two plants are grown as one and praised or blamed as 'Russian Comfrey', apart from mixtures and even *S. officinale*, under the name originated to avoid confusion with less productive varieties. Happy is the crop with no botanical history.

Professor K. W. Braid, of the West of Scotland Agricultural College Botany department, gives a diagrammatic picture of the situation that fits the observed facts in Fig. 4. The modern Comfrey grower takes his eighty to a hundred tons an acre from the 'centre party' variations on *S. peregrinum*. These are propagated vegetatively and though it is possible that higher-yielding hybrids may be selected, purchase of crowns from a stock that has produced the high tonnage that makes the crop pay is the only safe policy. Though the main characteristics are the magenta flower colour and the absence of wings on the flower stem,

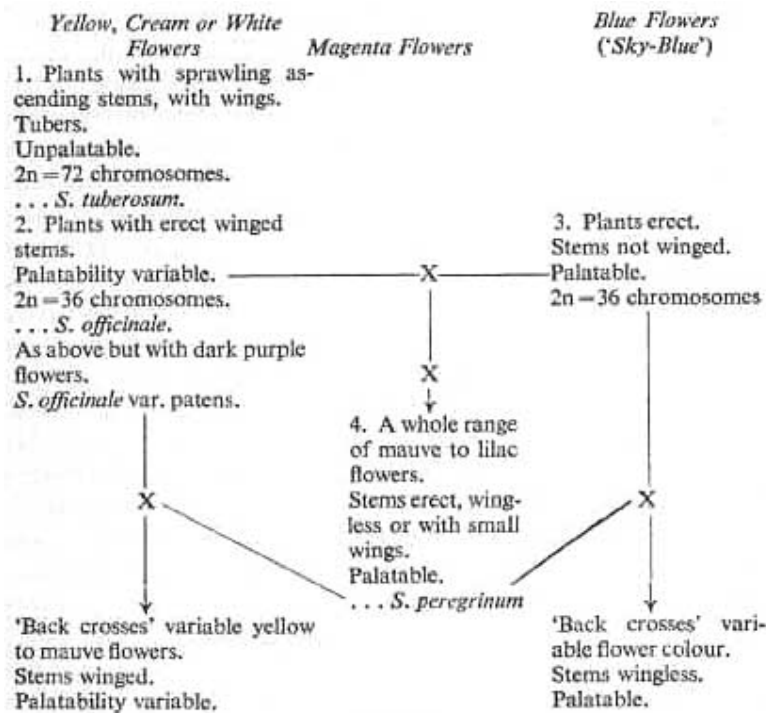


FIG. 4

Tentative hypothesis regarding the cultivated forms of *Symphytum*. The space above 4 is empty as Henry Doubleday's import may have been either a species or a natural hybrid occurring in Russia or Britain. This charts the situation to-day, the genes for high production and nutritional value lie in the middle

botany deals with surface qualities. The genes that carry these details, especially flower colour, may be present without those for growth speed, nutritional value and high yield, in which no botanist is interested and which his methods are powerless to detect. In a human family the nose shape, hair and eye colour and general features of a famous ancestor may recur through generations, but not with perhaps his musical or mathematical ability.

Though botanical descriptions can be an inadequate guide in a mixed race, it should be said that there is no record of any Comfrey of agricultural value with yellow, cream or white flowers, and bright blue is associated with the lower yields. The 'wings' are extensions of the leaves downwards at the sides of the flowering stems as narrow fins or ribbons; their presence does not always mean a poorly cropping variety, but is a warning. The hollow stem is another bad sign, solid stems, magenta pink flowers and lack of wings are good ones, but yield per acre from the strain in question is the only sure guide. It is to be hoped that cut-by-cut yield records, the equivalent to milk recording or trap-nesting, will

in future replace the present custom of quoting Henry Doubleday.

The latest full and favourable account giving a yield of eighty tons an acre, is in *The Complete Grazier* by William Fream, published in 1900, but the plant is missing from his far more famous *Elements of Agriculture*. The lack of information in standard textbooks not only handicaps the plant in comparison with the grasses and legumes, it preserves as sole references the bad opinion of the past. The Irish farmer who pleaded for someone to tell him how to get rid of it, and the defects of George Fry's 'sweet ensilage' system in dealing with a high protein crop, still come out in modern letters from Advisory Officers hard pressed for an answer. It is safest to be brief and discouraging, for if your correspondent fails with the crop he will have a weed on his hands, and on that problem too, no text-book is a guide.

The main basis of the modern reputation of the Comfreys is *Forage Plants and their Culture* by Charles V. Piper (Macmillan & Co., New York, 1917). This American work describes the plant as growing from two to four feet high and producing rather watery fodder in several cuts. Experimental yields are given for this bright blue-flowered species, *S. asperrimum*, and Joseph Busch's discovery is not doing well across the Atlantic. In Ontario it yielded 9¾ tons in 4 cuts, in New York (the State, not the City) 14 to 16 tons. In Vermont 46 tons, in North Carolina 6½ to 17 ½ tons, and in Wisconsin 32½ tons (American tons, 2,000 lb.) all per acre. It is not possible to judge from the account how much care was taken to be sure that the only factor varied was climate, and that the same plant was grown in every case; the experiments may well have been done under perfect conditions. It does not, however, prove the Rev. Henry More of Carnew Castle's yield of 82½ tons impossible, or Dr. Auguste Voelcker mistaken in quoting this figure in his 1871 article. In this case the comparison is with the earlier introduction, not Henry Doubleday's yields.

Science is essentially measurement, but the more weight we give to these measurements, and figures calculated from them, the more important it is to be absolutely certain what it is we have measured. In this instance the figures are an accurate record of what the plant that was grown will yield, on that particular soil, with the particular manurial treatment, and on the particular cultural routine, apart from variation of season and suitability of climate, in each case. The crop in Vermont, grown by someone without so much knowledge of the plant and how to grow it, may well have been as handicapped as the same wheat variety on a 'C

category farm in Somerset, and an 'A' one in Norfolk, compared with the Irish *Symphytum asperrimum* in 1835.

A different account is given of the same species, with its small blue flowers, by E. Brandmuller in his article 'Prickly Comfrey as a Fodder Crop', published in *Farming in South Africa*, the Dominion equivalent of our Ministry publication *Agriculture* (Vol. 1, November 1926). He grew the plant at Vereeniging in the Transvaal on the High Veldt, and considered its qualities of drought resistance and heavy fodder yields of extreme value on his poor land. A quality of rather surprising value was its frost resistance; it stood up to 15° of frost in the cold nights of this area, though it died down in June and July as a survival of its normal herbaceous habit.

Unfortunately no yield figures are given; the writer contents himself, as seems the universal practice, with quoting Henry Doubleday and other authorities of the past, but it is certain that it did better than the plot in Ontario in 1915.

In Britain, during the years from 1900 to 1940, only a few new references occur. A hay analysis was made some time before 1916; it appears in *The Agricultural Notebook* by Primrose McConnell, B.Sc. (1916), and shows 18.5 per cent crude protein, against 13 per cent for the very best meadow hay; but the main progress was the slow banishment of books to higher shelves, and the salvage campaigns of two wars made the knowledge of the past still harder to find. The dead hand of Archaeology began to close, and the *Symphytums* become a pigman's legendary cure for scour, a gipsy herbal remedy and an interesting piece of 'country lore'; a myth and a mystery, with a hundred tons an acre of high protein fodder hidden in its heart.

CHAPTER II

The Modern Comfrey Growers and Research Results

The first of the modern Comfrey growers was the late J. Kenneth Crawley, of Lockerbie, Dumfriesshire. His interest began in 1938 when he planted a small area on the twenty-acre holding to which he retired, after a life spent as a land agent, in 1936. He carried out a number of experiments with the plant, feeding it mainly to cattle, sheep and pigs, but unfortunately the full records he kept were destroyed after his death in November 1943, a great and double loss to the cultivation of *Symphytum peregrinum* in this country. His first article, 'Prickly Comfrey—A Neglected Fodder Crop', in the *Scottish Farmer* for 28th February 1942, was followed by one entitled 'Prickly Comfrey' in the *Journal of the Land Agents' Society* for April 1942. In these articles he gives the result of an extensive search of the old accounts, all that he had been able to discover concerning feeding the plant to stock, and a cut-by-cut analysis of his first year yield from 2,250 May planted offsets of *Symphytum peregrinum* from the Webster strain.

| | <i>Moisture</i> | <i>Crude</i> | |
|--------------------|-----------------|-----------------|-----------------|
| | <i>Per cent</i> | <i>Protein</i> | <i>Fibre</i> |
| | | <i>Per cent</i> | <i>Per cent</i> |
| June cut | 86.50 | 19.22 | |
| July 4th cut | 86.90 | 25.10 | 11.60 |
| July 24th cut | 90.03 | 25.77 | 8.48 |
| August 23rd cut | 87.09 | 24.00 | 9.70 |
| September 25th cut | 85.06 | 25.37 | 8.70 |
| October 14th cut | 90.30 | 26.25 | 11.20 |
| November 18th cut | — | 25.50 | 9.18 |

(Figures on a dry matter basis.)

As a result of these articles he was snowed under with letters and requests for plants from all over the country, and he divided and redivided his crop to fill the demand, in aid of the local Nursing Association. He was, however, not interested in sales so much as in vindicating a crop from the past with great possibilities of helping in the war-time stock-feed shortage, and in experiments to find the best ways of feeding it and conserving it for the winter. Very many of his practical discoveries, from his writings and the memories of his farm workers, are incorporated in the present book, and he can perhaps be described as the father of modern Comfrey growing. No yield figures remain, but the 70-yard long and

15-yard wide patch, kept undivided for pig food, which was crossed four times a season, is estimated by his foreman to have produced between 45 and 60 tons a year on a very poor soil.

In 1943 he was immensely concerned with the botanical problem and corresponded at length with his friend, Professor K. W. Braid of the Botany Department of the West of Scotland Agricultural College (see Appendix I) and other authorities, on the confusion of hybrids and species. He intended to write an article on the whole question, which his death, at the age of 70, prevented. He was the first man to insist that the Comfrees were genetically mixed, and that to damn the good crops on the evidence of entirely different plants is fundamentally unsound. The yield figures he quoted were from Henry Doubleday, who grew the same plant, but on a good Essex clay, and the two men, separated in time, had much in common. Agriculture owes a great deal to these small men with education, ideas and keenness for research—orthodoxy may, at low levels, scorn the man 'with a bee in his bonnet', but quite often this turns out to be a worker bee.

One of Mr. Crawley's many friends was Mr. E. V. Stephenson, the well-known racing-stud owner of Little Weighton, and about 1942, what is now a unique Comfrey patch was planted, with offsets of *Symphytum peregrinum*. This was a tree-shaded three-quarters of an acre, the former site of two old cottages on a poor and very stony Yorkshire limestone soil, near the stable yard and farm buildings and convenient for cutting. Entirely by accident (some chickens escaped and were lost among the great leaves for some days), Mr. Stephenson discovered his simple weeding system. Fowls of any age will not touch Comfrey when it is stiff and growing, they eat only the weeds between the rows, and though Henry Doubleday observed in one of his letter to the *Gardeners' Chronicle* that pheasants did exactly this, no one had ever hit on this solution to the weed difficulty before. This plot, with a semi-intensive poultry flock on it, is the only one that has been kept clean and cut for a long period, and therefore its owner is completely satisfied with it.

No yield records were kept, it is crossed between five and seven times a year according to fodder needs, the daily rations being cut by hand and fed as required. Apart from an occasional stirring with a horse hoe, and manuring in the spring, no further labour is expended on this crop, which is growing where only nettles grew before, the rubbish corner to be found on almost every farm in Britain. Approximate weights per season, judged roughly by the daily cuts, give between sixty and eighty tons an acre to-day, and when

newly established, about its fourth and fifth years, it gave more, probably hitting the 100-ton-an-acre mark or passing it.

At first it was used for poultry, calves and pigs, some of it being fed to horses, but its success in improving the condition and curing and preventing scour in mares and foals, as well as young pigs, has resulted in the main crop being reserved for the blood stock. It is fed daily to the stallions, and to all horses brought into the loose boxes as 'off colour' or mares foaling, as part of the standard diet.

The leaves of *Symphytum officinale* and its hybrids, or abandoned escapes of the fodder Comfreys have been fed as a tradition by gipsy horse copers to bring their wares into condition before a fair. This supplementary diet puts the gloss of health on the coat even of a beast doctored by methods with less veterinary and nutritional justification. Fed to about £100,000 worth of race-horses a year, *Symphytum peregrinum* merits Mr. Stephenson's high opinion of it as part of the diet for thoroughbreds. The trace of Allantoin in the foliage is small, the calcium in organic combination revealed in the ash may be also of value to the foals. Veterinary research may later lend support to this experienced breeder who has found that no Comfrey in the diet means occasional cases of scour, but a regular ration means none.

Mr. Stephenson attempted to establish plants in his stallion paddock so that it could be grazed, but the result was a heavy fall in yield and the Comfrey merely struggled along as a weed; an experiment that is still tried again and again. It is only a crop when it is kept clean, cut and manured.

The same experiment ruined the twelve-year-old plot grown by the Soil Association at their Haughley Research Station. This was planted with *Symphytum peregrinum* to produce compost material, but proved so useful as stock feed, especially for pigs, that it was never used for this purpose. The land was old permanent pasture, and in ten years only one dressing of compost was given; no manure of any kind was ever applied. It was cut on a daily rotation and the yield steadily increased for the first seven years. No records were kept, but the average yield per plant is conservatively estimated at 3 lb. per cut, with seven crossings of the quarter-acre patch, containing 1,000 crowns, in each season, which is approximately 45 tons an acre. It may well have been more, it was certainly not less.

Unfortunately, owing to a change of manager (the main reason for a fall in Comfrey yields on any farm), it was allowed to become weedy, and the production dropped

sharply. Lady Eve Balfour's most important discovery was the way in which allowing the plant to run up to stem and flower before cutting would cripple the yield for the rest of the season. One can spoil a crop as easily as ruining a cow in milk by neglect. The next season's cut is unimpaired, but very many experimenters must have produced their low yields through ignorance of this point. A bull was then tethered on the plot; it ate the Comfrey greedily, but by trampling and close grazing it reduced the crop to the weed condition in which it is found on many farms.

Early in 1950 a trial was made at Messrs. Wissington Estates' Nurseries at Southery, on the possibilities of *Symphytum peregrinum* as a crop for the grass drier. Several other fodder crops and grasses were on trial, and when it was discovered that the meal produced, though high in protein and low in fibre, was so dark as to be unsaleable, the experiments were discontinued. In the trial, however, the experience of the Drier staff enabled them to overcome what has been regarded as the unsurmountable obstacle to conserving the crop by this method, the thick, fleshy stems which dry more slowly than the leaves. The crop was wilted and put through a 'Robust' shredder, in the same way as kale, Brussels sprout stems, unsold cabbage or sugar-beet tops, and proved no more difficult to dry.

The yield in five cuts in the year of planting was at the rate of 36 tons an acre, and had the experiment continued for four years, it is likely that even Thomas Christy's 150 tons would have been exceeded. It was on a field that in the 1952 harvest produced 2½ tons of wheat an acre. It was fed to dairy cows on pasture as a wilted supplementary food, and it was cleared up every time. There were no facilities for nutritional experiments and the only thing that could be established was that the animals (on a first-class new ley of Aberystwyth leafy-strain grasses) ate it readily, and so did pigs. As it was wilted the palatability question did not arise. The fresh weight carotene in the leaves was determined on this nursery by Dr. R. O. Booth of the Dunn Nutritional Laboratory, Cambridge, for the first time in history. The writer, who managed the nursery, dates his interest in the crop from these experiments.

In 1946 the *Symphytums* had their first mention in any British Ministry of Agriculture publication. In the February number of their Journal, *Agriculture*, W. Holmes, B.Sc, N.D.A., N.D.D., of the Hannah Dairy Research Institute, Kirkhill, Ayr, wrote an article 'Prickly Comfrey', including the following analysis of meal dried in a conveyor-type grass

drier, with considerable difficulty from the unshredded thick stems.

| | <i>Per cent</i> |
|-----------------------|-----------------|
| Moisture | 11.0 |
| Crude protein | 22.7 |
| Oil | 2.7 |
| Crude fibre | 10.9 |
| Soluble carbohydrates | 38.2 |
| Ash | 14.5 |
| | 100.00 |

| | <i>Per cent</i> |
|---------------|-----------------|
| Calcium (CaO) | 1.41 |
| Phosphorus | 1.07 |
| Carotene | 400 mg. per kg. |

'The claims made for the plant (*Symphytum asperrimum*, with small blue flowers) were based on this sort of analysis figure, and reports in the improvement in the health of unthrifty animals after being fed on the wilted leaves.

'They were not supported by the first-hand experience at the Hannah Institute farm, where a half-acre plot has been grown for several years. The rather upright growth of the plant and the necessity for fairly frequent cutting to provide young leafy herbage, prevent it covering the ground rapidly, and as a crop, therefore, it is rather difficult to establish and liable to serious weed infestation. The two most successful methods of establishment proved to be in rows two feet apart, and close-planted and intersown with Italian rye grass. With the first method cleaning may be done with row-crop equipment, with the second, the grass fills the spaces and weed growth is smothered. Once established, the crop comes into growth early in the spring and, when cut at regular intervals, continues to yield fresh leafy herbage until the first severe frost.'

Yields of Green Comfrey
(88 per cent moisture)

| | |
|------|---------|
| 1943 | 9 tons |
| 1944 | 12 tons |
| 1945 | 8 tons |

'To summarize, as a summer soilage crop, comfrey is less productive than, for instance, cereal-legume mixtures, and with the methods and equipment at present available it is unsuited for preservation for winter use. Owing to its very limited value for feeding purposes and the difficulties associated with its management and utilization, it is doubtful

whether its cultivation on any considerable scale would be worth while.'

In correspondence with the writer, who sent a photograph of one of the Southery plants just ready for a 10-lb. cut, 4 feet high and 4 feet across, Mr. Holmes gave the following supplementary information: The plants were supplied by the late Kenneth Crawley in 1942 to Dr. Fowler, who was then in charge of the department. The land was not good but not poor, it had previously produced 16 tons of cabbage an acre and the crop received at least one heavy dressing of dung during its life. In 1945 the first cut of the four taken per season was 30 cwt. from the half-acre on April 20th and 28 cwt. on May 30th; the balance of the 8 tons was made up on the cuts July 13th and October 6th. Only in the July cut were any flower stems seen. It is not known exactly how much of the crop was clean-cultivated and how much under rye grass, and the plot is now ploughed up and its blue-flowered descendants remain as weeds.

The Hannah Dairy Research Institute record for a low yield has only been beaten by Ontario and North Carolina, as reported by Charles V. Piper, whose 'Forage Crops and their Culture' is quoted at the beginning of the article. While it is not possible to identify *Symphytums* entirely by flower colour, the magenta pink of the leading strain of *S. peregrinum* is a characteristic; it is shared by others, but a vivid blue is, by every record, a sign of a low yielder. We know that the late Kenneth Crawley had several strains, we know that he took up the botanical aspect seriously only in 1943, and it is possible that the plants he sent to Hannah were exactly what Mr. Holmes and Charles V. Piper expected, *S. asperrimum*.

Nevertheless, the writer has pleasure in quoting the unaltered opinion of an authority of Mr. William Holmes's standing, as a warning that he himself may be wrong. This article proves that you can get a very low yield of Comfrey; it depends which *Symphytum* you grow, and how well you grow it, like any other crop. Plate 7 shows the effects on Comfrey of grass between the plants.

Trials in Denmark reported in Dr. A. Petersen's *Landbruget Plantekulture II* (see Bibliography) show yields of between 12 and 40 tons an acre, and because of the low dry matter the crop is regarded as greatly inferior to the legumes. It has been sold with much publicity of a catch-penny type on the Continent, under the names of Porkin, Comfrey, *Symphytum*, *Asperrimum* and *Asperum*, but official opinion is that the yield is too small to be worth the difficulty of cultivation. It has been tried from 1918 to 1921 at the

Lyngby, and for fifteen years at the Askov Agricultural Research Stations, who both support the view that the Comfrey with vivid blue or blue violet flowers will not produce more than 45 tons an acre. As may be remembered from page 17 James Grant himself claimed only from 40 to 60 tons for this species, and on poor soils it is unlikely that his



5. A 10-lb. Russian Comfrey ready to cut, at 'fountain of leaves' stage. The 3-gallon can shows the size.



6. A trial row at Southery Nurseries. Plants in the foreground were cut about ten days earlier. July 1950.



7. Good Comfrey ruined by grass, weeds and close grazing. A selective weed-killer might save the crop, but better farming is cheaper.

upper yield would be achieved, nor that of the Rev. Henry More, without heavier manuring than would be afforded an agricultural curiosity grown as a specimen plot.

In Germany, as in most Continental countries, the main Comfrey grown is *Symphytum asperrimum*. James Grant seems to have exported on a large scale, and *S. peregrinum* arrived via Thomas Christy in far smaller quantities. Very many attempts were made to establish it from seed, and as *Symphytum officinale* is widely distributed, exactly the same results occurred as in England. The crop is mixed, its methods of cultivation are only partly understood, and authority is concisely and most helpfully unfavourable. It is grown successfully by a few peasants, from whom (via a German friend) the author heard of the pig system of destruction. A very full report from the German Agricultural Authorities gives a complete picture of the mirror image of our British muddle, with one Dr. H. Weber, a landowner of Mecklenburg, a Teutonic Henry Doubleday, who introduced *S. peregrinum*, selecting the solid-stem form which he called 'Matador' and advocated for pigs in 1908.

The final event in the history of the Symphytums is as characteristically mid-twentieth century as Joseph Busch's journey to St. Petersburg was of the eighteenth. A student in the autumn of 1952 went quietly into the Russian Zone and consulted their agricultural libraries on behalf of the writer. This revealed that the silence of the authorities of the

U.S.S.R. in reply to the writer's attempts to draw information on Russian Comfrey, of the type that is available to all men at H.M. Stationery Office about every crop we grow, had no sinister origin. The Symphytums in modern Russia are merely rather obscure mountain plants, perhaps found rarely in herbaceous borders in a country where private gardens are not so widely popular as in Britain. Unlike that of any similar investigation in any British or German agricultural library containing books spanning back to the 1850's, the result was a blank—'Only a short remark concerning Symphytum by Prjanianikow, who do not believe useful such a culture.'

There is no record from any country of modern work on *Symphytum peregrinum* grown by the methods described in this book, which are those that have produced 100-ton per acre yields and are still producing them, from small areas and very occasionally from as much as an acre. A questionnaire sent in the autumn of 1952 to Messrs. Webster's customers for over a thousand plants between 1946 and 1949, showed that where the farm had not changed hands and the new owner ploughed up the crop without understanding its needs, the growers were getting very considerable yields, variously estimated between sixty and eighty tons an acre in a season. One farmer, whose address is available to research workers, but who has no wish to be snowed under with correspondence, gives the following figures for *Symphytum peregrinum* over three years old:

| | Per Plant | | Low | | High | | |
|-----------|-----------|------|------|------|------|------|-----|
| | lb. | Tons | Cwt. | Qrs. | Tons | Cwt. | Qrs |
| Cut one | 5-8 | 10 | 15 | 3 | 17 | 5 | 1 |
| Cut two | 12-15 | 25 | 17 | 3 | 32 | 7 | 0 |
| Cut three | 12-15 | 25 | 17 | 3 | 32 | 7 | 0 |
| Cut four | 8-5 | 10 | 15 | 3 | 17 | 5 | 1 |
| Cut five | 3 | 6 | 9 | 2 | 6 | 9 | 2 |
| TOTALS | | 79 | 15 | 0 | 105 | 14 | 0 |

This grower found that it was very easy to keep clean, no weeds grew under the plants, so no hand hoeing was needed; a clean up of the middles between early and late cuts was all that was required. On an eight-cut rotation as for pigs this yield would have been exceeded; the two peaks of cuts two and three pulled down the average afterwards. The main problem on the mixed farm is that, though the crop is useful at both ends of the year, the main cuts have often to be left to waste in June and July with a flush of grass. The problems of making silage of this crop deserve a concerted attack for the benefit of those who can grow the weight. The high protein made one man's silage produce a swarm of maggots as though meat had been included in the pit. The one factor

which was constant in all cases was that each man had the same variations on the theme of *S. peregrinum*; many failed because of the brief and optimistic instructions of the sellers, sound but insufficiently full in the circumstances.

No branch of the Agricultural Advisory Services or any farming periodical will give any help; the inquirer will be informed that he has a weed and given a quotation from the past, when what he needs is help in conserving perhaps thirty tons of fodder ready to cut, with more on the way. The most successful silage maker, a Surrey farmer who makes 300 tons of cereal-legume mixture silage a year, merely mixes the wilted Comfrey from his acre in with the rest; the high carbohydrate of the mixture levels up the high protein in the Comfrey, and the result is more silage of a slightly better nutritional value which is much appreciated by cattle. The two 'ends' of the crop are fed wilted if pastures are thin. As a very rough guess this means between fifty and sixty tons more silage, from about an acre of Comfrey.

By extensive advertising and mass observation methods it would be possible to secure the addresses of many small Comfrey growers whose yields, from a few dozen plants, could be multiplied up to well over the 100 tons, but the work of weighing cut by cut and plant by plant six or eight times a year is a job no farmer will undertake. Analyses are easy, and plenty are available, but the author earnestly appeals to all who grow Comfrey to do just this back-aching work with a sack and a good spring balance. He welcomes correspondence with Comfrey experimenters, especially those with firm yield figures from the 1950's. The type of letter both the late Kenneth Crawley and the writer received in shoals is brief, enthusiastic and unfigured—'My Comfrey grows simply *huge*, I cut about a barrow-load most days, both goats *love* it, and the pigs!' Plants averaging under 1 lb. per cut each, producing eight tons a season, do not strike anyone as 'huge', but adjectives are of little statistical use. Garden-scale crops yield more than in the field, but their product is just as much a help to the national larder in terms of home-produced meat.

In general the better the crop is grown the fewer the headaches, the 70- to 100-ton men have little weed worry; they merely grow the crop as they have learnt how and do not give advice or write to periodicals.

The question is, what exactly is this 100 tons an acre worth in terms of stock feed? Is it enough to make it worth while learning how to grow this crop and to write off its high first cost of approximately £60 an acre for offsets?

Table 1 is taken from the Ministry of Agriculture Bulletin No. 48 'Rations for Livestock' (Her Majesty's Stationery

Office, twelfth edition, 1952. 4s.). Professor H. E. Woodman, the author, confirms that the analysis of 'Comfrey' under 'Miscellaneous Green Crops' on page 117 is from the German authority, Dr. Kellner (it therefore probably applies to *Symphytum asperrimum*), but that the 'Comfrey (Russian)' which appears between Coffee Wastes and Cottonseed Bran on page 128 among the By-Products, is from an analysis made by Dr. Eden, Chief Nutritional Chemist to the N.A.A.S., of a sample of *Symphytum peregrinum* sent in during the summer of 1949. This has been traced to its owner and its identification confirmed. The presence of this figure on the wrong page is, of course, a misprint, an example of the kind of luck that Comfrey has had for the past fifty years. The figures in columns (7) to (14) are calculated in this one instance by W. D. Hills, B.Sc. who prepared the tables on the same basis as those for the normal Comfrey in the line below. Otherwise they are from the Bulletin, to which the reader is referred for an explanation of the 'V factor in Column (13), the co-efficient of digestibility and how to use it in calculating rations for cattle.

TABLE 1 COMPARATIVE VALUE OF FODDER CROPS

| DATA EXTRACTED FROM BULLETIN No. 48. RATIONS FOR LIVESTOCK BY PERMISSION OF H. M. STATIONERY OFFICE. | | AVERAGE COMPOSITION PERCENT AS SHOWN BY CHEMICAL ANALYSIS | | | | | | DIGESTIBLE NUTRIENTS PER CENT | | | | | CALCULATED FROM DIGESTIBLE NUTRIENTS | | |
|--|--------------------------------|---|------------------|------------------------|--|-------------|-----|-------------------------------------|----------------------------|--------------------------|--|---------------------|--|----------|-------------------------------------|
| | | DRY MATTER | CRUDE PROTEIN | OIL (ETHER EXTRACT) | CARBOHYDRATE (NITROGEN-FREE EXTRACTIVES) | CRUDE FIBRE | ASH | DIGESTIBLE CRUDE PROTEIN | DIGESTIBLE TRUE PROTEIN | P.C. OIL (EXTRACT) | DIGESTIBLE CARBOHYDRATE (DIG. NITROGEN- FREE EXTRACTIVES) | DIGESTIBLE FIBRE | NUTRITIVE RATIO (APPROX.) | V FACTOR | STARCH EQUIVALENT PER 100 LB. |
| | | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) | (13) | (14) |
| PAGE | CROP | | | | | | | | | | | | | | |
| 128 | COMFREY (RUSSIAN) | 12.4 | 3.4 | .3 | 4.9 | 1.5 | 2.3 | 2.04 | 1.22 | .2 | 3.62 | .7 | 1:2.8 | 91 | 5.32 |
| 117 | COMFREY | 11.5 | 2.5 | .3 | 5.0 | 1.7 | 1.5 | 1.5 | .9 | .2 | 3.7 | .8 | 1:3 | 91 | 5.2 |
| 114 | CABBAGE (DRUMHEAD) | 11 | 1.5 | .4 | 5.9 | 2.0 | 1.2 | 1.1 | .7 | .2 | 4.6 | 1.4 | 1:6 | 94 | 6.6 |
| 115 | MAIZE (GREEN) | 19.4 | 1.7 | .5 | 10.4 | 5.6 | 1.0 | 1.0 | .6 | .3 | 6.7 | 3.1 | 1:10 | 83 | 9.1 |
| 115 | RAPE | 14.1 | 2.8 | .8 | 5.7 | 3.5 | 1.3 | 2.0 | 1.3 | .5 | 3.9 | 1.9 | 1:3 | 87 | 6.9 |
| 115 | MARROWSTEM KALE (UNTHINNED) | 14 | 2.2 | .5 | 6.9 | 2.5 | 1.9 | 1.7 | 1.2 | .3 | 6.1 | 1.6 | 1:4.9 | 93 | 9.1 |
| 117 | LUCERNE (EARLY FLOWER) | 24 | 4.1 | .4 | 9.9 | 7.2 | 2.4 | 3.1 | 2.0 | .1 | 6.6 | 3.2 | 1:3.2 | 80 | 10.3 |
| 115 | PASTURE GRASS (NON-ROTATIONAL) | 20 | 5.3 | 1.1 | 8.9 | 2.6 | 2.1 | 4.5 | 3.8 | .7 | 7.8 | 2.1 | 1:2.5 | 95 | 14.7 |
| 116 | RED CLOVER | 19 | 3.4 | .7 | 8.1 | 5.2 | 1.6 | 2.5 | 1.7 | .5 | 6.3 | 3 | 1:4 | 86 | 10.2 |
| 116 | RYE GRASS (ITALIAN) | 25 | 3.4 | 1.0 | 11.6 | 6.2 | 2.8 | 2.1 | 1.3 | .5 | 7.7 | 3.6 | 1:6 | 85 | 11.4 |

| TABLE 2. | WILTED FOOD VALUES | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) | (13) | (14) |
|-------------------|-----------------------------|------|------|-----|------|------|-----|-----|------|------|------|------|-------|------|------|
| COMFREY (RUSSIAN) | WILTED FROM 87.6% TO 85% MC | 14.7 | 4.16 | .37 | 6.0 | 1.82 | 2.8 | 2.5 | 1.5 | .24 | 4.4 | .65 | 1:2.8 | 91 | 6.5 |
| " | " " 87.6% " 80% " | 20.0 | 5.5 | .48 | 7.9 | 2.4 | 3.7 | 3.3 | 1.93 | .326 | 5.8 | 1.13 | 1:2.8 | 91 | 8.4 |
| " | " " 87.6% " 75% " | 25.0 | 6.85 | .6 | 9.8 | 3 | 4.6 | 4.1 | 2.46 | .4 | 7.27 | 1.44 | 1:2.8 | 91 | 10.5 |
| " | " " 87.6% " 65% " | 35.0 | 9.5 | .85 | 13.8 | 4.25 | 6.5 | 5.7 | 3.45 | .56 | 10.0 | 2.0 | 1:2.8 | 91 | 15 |

TABLE 1. Comparative analysis of Comfreys and other Fodder Crops.

TABLE 2. Wilted analysis of Russian Comfrey.

From this we see that *Symphytum peregrinum* and *Symphytum asperrimum* contain less dry matter, ton for ton,

than any other fodder crop except Drumhead Cabbage, which has winter availability as a hidden asset. On crude protein, *S. peregrinum*, ton for ton, is beaten by good pasture grass and Lucerne, and is level with Red Clover and Italian Rye Grass; on carbohydrates it is at the bottom of the list, but it contains less crude fibre than any other crop. Lucerne contains roughly five times as much. All these figures are on a fresh weight basis; some misleadingly favourable comparisons have been made in the past between Russian Comfrey, on a dry matter basis, and Marrowstem Kale on a fresh weight one. Here one can follow the crop across the page in comparison with its fellows, bearing in mind that Rape is a quick catch crop, and as such has very many more advantages than slightly more digestible carbohydrates and slightly less digestible crude protein, and that Red Clover, with not quite double the starch equivalent, is also a nitrogen fixer.

Table 2 is of wilted values for Russian Comfrey, included because most stock eat the wilted plant only; other green foods wilt richer, they also wilt to reveal very much higher fibre. It is for use in later chapters on stock feeding, and is not relevant as a standard of comparison. All green fodder crops are mainly water, and often, as the Scottish farmer said about his mangolds, 'Och, but it's dam guid watter'.

This type of comparison is extremely valuable with purchased feeds, but to give a complete picture one needs a record in terms of how much in nutrimental harvest an acre yields. Labour costs, ease of cultivation and many other factors come in also, so does the extreme variation of soil from farm to farm and season from year to year. Table 3 is calculated in pounds weight per acre, the ton, the hundredweight and the quarter have not been used because of space difficulties and the complication of the American ton of 2,000 lb. The yields for crops other than the Comfreys were extremely difficult to secure; many fodder plants have been left out purely because, like sainfoin, there is no recorded evidence that they produce anything at all. These are kindly selected by the Grassland Research Station (with the exception of Green Maize from *Agriculture* by Sir James A. Scott Watson and James A. More (Oliver & Boyd, ninth edition, 1949)), and they are of a moderate yield and a really good one. The writer has never seen a fifty-ton per acre crop of Marrowstem Kale as an example, and the 'as grazed' figure for pasture is for a really good ley of pedigree grasses.

At twenty tons an acre per season, though both Comfreys produce more dry matter in tons per acre than a low yield of anything else, except pasture grass (*S. peregrinum* wins here

on a photofinish), and they lead on crude protein, they are beaten on carbohydrates by everything except low-yielding lucerne, low-yielding rape and also the lower yield of red clover and Italian rye grasses. (These two are lumped together, as pure red clover is rarely grown except for seed.) The same balance holds all across through the digestible nutriment. A new column has been added for the benefit of pig-and poultry-men. Starch equivalent includes digestible fibre—it is of extreme value in calculating the rations of grazing animals, but pigs and poultry digest so little that the total without fibre is included as a nearer approach to what they do digest.

On this basis, with so little difference in nutriment per acre and that easily vanishing from a rather better yield from the alternatives, the crop is not worth growing, at eight tons or even twelve; the opinion of the Hannah Dairy Research Station is well justified. With its disadvantages of spreading the yield through the season and difficulty of eradication, both Comfreys are very bad bargains for the man with a low yield. When this amount of nutriment is merely a poor first-year cut, to be compared with three tons an acre for first-year lucerne, or a single summer cut from a well-grown field, the position changes.

At fifty tons, about the yield of the Soil Association's unmanured plot, a low figure often achieved and quoted, only the fifty-ton crop of kale is ahead on dry matter, and *S. peregrinum* is over 850 lb. more than the best pasture grass yield of crude protein. Good lucerne is still leading on fibre, and maize and kale on carbohydrates. At this figure then the crop pays the pig- and poultry-man, giving the green fodder vitamins and vegetable protein with the least possible fibre, at the lowest labour cost per ton. It also pays the race-horse breeder and riding-stable proprietor with the concealed subsidy of improved condition. On the dairy farm, except where the pastures are late starting on a cold, heavy clay, or dried up from July onwards in bad years, orthodox fodder and grazing crops at their best still lead. Where the comparison is with the lower crop yields, or below them, and Comfrey will pull in fifty tons from a poorer soil, the scale goes down in favour of the plant, despite its problems.

With between seventy-five and a hundred tons an acre, the yield of established and well-grown Comfrey for the past seventy years since Henry Doubleday, the picture is completely altered. The labour cost has remained constant, so has the first cost of planting; the only increase to set against double the food production is that of harvesting the greater bulk, and in petrol or T.V.O., and labour and machinery

running-time costs. This is a small figure. It becomes worth reorganizing the farm programme to fit the yield, taking rather more trouble with silage-making to fit in the summer cuts, either as a mixture or alone, and working out the stocking system that will best utilize the bulk of feed.

The crop is like a jet engine, inefficient at low speeds, but a winner in the stratosphere, and when through the 100-ton 'sound barrier', its advantages rise still more sharply. At twenty tons and below it is a weed and a headache, justifying all that has been said against it; with five times the yield it is a crop that deserves the most serious consideration.

The comparison with lucerne should not be pressed too far. Both crops are perennial and non-rotational, both are best cut in succession through the summer, and both have a weed problem. Lucerne is, however, a nitrogen fixer, and not a nitrogen consumer, it grows best on the chalk subsoil where Comfrey does badly, and has the advantage that it can be grown as part of a ley with grass, apart from its higher carbohydrates. Comfrey thrives on the heavy clay and in the cold districts where lucerne is difficult, it is in cut over a longer period, far more easily established, and the yield is vastly greater when it is grown well. There is no record of land ever growing 'Comfrey-sick', and none of any crop lost by any pest or disease of any type.

Though the maximum yield per acre is Britain's need, it is profit per acre that turns the wheels of agriculture. The economics of farming with Comfrey are as yet unknown. So far the crop has been a hand-cultivated experimental plot in almost every case. Even on this scale it has paid some growers, but with mechanized harvesting, weeding (and largely manuring) by poultry, or selective weed-killers, and better methods of conservation, it offers a considerable saving on the labour cost of self-sufficiency on the farm.

| TABLE 3. | | COMPARATIVE YIELD PER ACRE CALCULATED FROM TABLE 1 | | | | | |
|---|---|---|---------------|------------------------|--|-------------|------|
| CROP YIELD FIGURES, OTHER THAN COMFREY, FROM THE GRASSLAND RESEARCH STATION | ANNUAL YIELD PER ACRE IN TONS | DRY MATTER | CRUDE PROTEIN | OIL (ETHER EXTRACT) | CARBOHYDRATE (NITROGEN-FREE EXTRACTIVES) | CRUDE FIBRE | ASH |
| | | TONS | lb. | lb. | lb. | lb. | lb. |
| | | (1) | (2) | (3) | (4) | (5) | (6) |
| COMFREY (RUSSIAN) | 100 | 12.4 | 761.6 | 672 | 11,000 | 3360 | 5152 |
| " | 75 | 9.3 | 570.7 | 404 | 8250 | 2520 | 3864 |
| " | 50 | 6.2 | 380.8 | 336 | 5500 | 1680 | 2576 |
| " | 20 | 2.49 | 155.3 | 134 | 2200 | 672 | 1031 |
| COMFREY | 100 | 11.5 | 5600 | 672 | 11,200 | 3808 | 4480 |
| " | 75 | 8.62 | 4200 | 404 | 8400 | 2856 | 3360 |
| " | 50 | 5.75 | 2800 | 336 | 5600 | 1904 | 2240 |
| " | 20 | 2.3 | 1120 | 134 | 2240 | 762 | 896 |
| CABBAGE (DRUMHEAD) | HIGH 50 | 5.5 | 1680 | 448 | 6608 | 2240 | 1344 |
| " | LOW 20 | 2.2 | 672 | 179 | 2644 | 896 | 535 |
| MAIZE (GREEN) | HIGH 25 | 4.84 | 950 | 280 | 5824 | 3136 | 560 |
| " | LOW 10 | 1.94 | 382 | 110 | 2330 | 1254 | 224 |
| RAPE | HIGH 20 | 2.82 | 1254 | 357 | 2554 | 1568 | 572 |
| " | LOW 10 | 1.41 | 627 | 179 | 1277 | 784 | 236 |
| MARROW- STEM KALE (UNTHINNED) | HIGH 50 | 7.0 | 2464 | 560 | 7728 | 2800 | 2188 |
| " | LOW 15 | 2.1 | 740 | 168 | 2318 | 840 | 638 |
| LUCERNE EARLY FLOWER | HIGH 18 | 3.32 | 1658 | 161 | 4000 | 2902 | 965 |
| " | LOW 9 | 1.66 | 829 | 80 | 2000 | 1451 | 482 |
| PASTURE GRASS, NON-ROTATIONAL | HIGH 25 | 5. | 2950 | 618 | 4984 | 1450 | 1175 |
| " | LOW 12 | 2.4 | 1422 | 295 | 2390 | 695 | 566 |
| RED CLOVER AND ITALIAN RYE GRASS | HIGH 15 | 3.3 | 1142 | 286 | 3319 | 1916 | 739 |
| " | LOW 8 | 1.76 | 610 | 153 | 1768 | 1020 | 394 |

| COMPARATIVE YIELD PER ACRE CALCULATED FROM TABLE I. | | | | | | | |
|--|----------------------------|-------------------------------------|--|------------|--|--|--|
| DIGESTIBLE CRUDE PROTEIN | DIGESTIBLE TRUE PROTEIN | DIG. OIL (DIG. ETHER EXTRACT) | DIG. CARBOHYDRATE (DIG. NITROGEN - FREE EXTRACTIVES) | DIG. FIBRE | TOTAL STARCH EQUIVALENT PER ACRE | TOTAL DIGESTIBLE MATERIAL PER ACRE COLUMNS (7) + (10) + (11) + (9) x 25 | DIGESTIBLE BY PIGS AND POULTRY COLUMNS (8) + (10) + (11) x 2.25 |
| lb. | lb. | lb. | lb. | lb. | lb. | lb. | lb. |
| (7) | (8) | (9) | (10) | (11) | (14) | (15) | |
| 4569 | 2736 | 448 | 8108 | 1568 | 11917 | 15253 | 11852 |
| 3426 | 2052 | 336 | 6081 | 1176 | 8937 | 11439 | 8889 |
| 2284 | 1368 | 224 | 4054 | 784 | 5958 | 7626 | 5926 |
| 914 | 549 | 90 | 1621 | 313 | 2383 | 3950 | 2370 |
| 3360 | 2016 | 448 | 8288 | 1792 | 11648 | 14448 | 11312 |
| 2520 | 1512 | 336 | 6216 | 1344 | 8736 | 10836 | 8484 |
| 1680 | 1008 | 224 | 4144 | 896 | 5824 | 7224 | 5656 |
| 672 | 403 | 90 | 1657 | 258 | 2329 | 2889 | 2262 |
| 1232 | 784 | 224 | 5152 | 1560 | 7392 | 8446 | 6440 |
| 493 | 312 | 90 | 2061 | 624 | 2957 | 3380 | 2600 |
| 560 | 336 | 168 | 3751 | 1736 | 5097 | 6425 | 4465 |
| 224 | 134 | 67 | 1500 | 694 | 2028 | 2570 | 1785 |
| 896 | 582 | 224 | 1747 | 851 | 3491 | 4000 | 2833 |
| 448 | 291 | 112 | 873 | 426 | 1746 | 2000 | 1416 |
| 1906 | 1344 | 336 | 6832 | 1792 | 10192 | 11276 | 8922 |
| 577 | 403 | 100 | 2050 | 538 | 3058 | 3390 | 2678 |
| 1250 | 806 | 40 | 2661 | 1290 | 4153 | 5281 | 3557 |
| 625 | 403 | 20 | 1330 | 645 | 2072 | 2645 | 1783 |
| 2520 | 2128 | 392 | 4368 | 1176 | 8182 | 8946 | 7378 |
| 1218 | 1023 | 188 | 2100 | 564 | 3925 | 4305 | 3546 |
| 775 | 504 | 168 | 2352 | 1109 | 3628 | 4672 | 3234 |
| 412 | 269 | 45 | 1250 | 591 | 1950 | 2460 | 1620 |

TABLE 3. Comparative yields in pounds per acre of the Comfrees and other fodder crops. The 'high' yields are record figures or near, the low ones average farm crops.

CHAPTER III

The Cultivation and Management of Comfrey

All species of Comfrey require a deep soil, not necessarily a good one, but deep. They owe their reputation for growing and producing on land where nothing else will grow to their long and powerful roots, which drive straight down, instead of spreading like those of the bracken. Their vertical search area is large, so they can tap subsoil water on dry soils, draw up calcium, phosphorus and potassium salts, not to mention trace elements, and recapture leached-out plant foods already over the 'horizon' so far as normal crops are concerned, by going down further than anything but sizeable trees. Moreover their suction power is considerable; the roots have a vigour far beyond that of any other plant, thick and strong and producing the acids that release plant foods from the hungry subsoil.

Their very bad reputation on this sort of soil is from the wide variety of reasons why 'nothing else will grow'. On poor stony soil, such as the Yorkshire wold limestone-fragment-filled corner used by Mr. E. V. Stephenson, with good manuring they will thrive; on sands a hard pan will defeat them, and they will need feeding on a considerable scale to produce a bulk of fodder. The soils which rule them out altogether are thin soils over rock—including chalk—pure peats, and land with a high water table. They need at least four feet foot-run, and a neutral soil; Ph. 6.0 is about as low as they can safely go.

On clays, loams, and sandy loams they are at their best, and there is no objection to a moderate flood risk, provided the land is well drained otherwise. The plant is used to very much colder winters than those in Britain and it can therefore be planted in frost pockets and cold spots, where the last cut will stand until late November in a normal year. It is also moderately shade-tolerant, and odd corners overhung by trees can be used, but it will not produce the weight of a good plot in the open. The Comfrey is unsuitable for planting under fruit, not only because of the difficulty of cutting the crop, and of picking and attending to the fruit, but because of the need for nitrogen-rich manuring, and the risk of a potash-grabbing contest between the fodder and the trees.

Trial Area Selection and Cultivation

On almost every holding there is land near the farm buildings that is often awkward in size and shape for tractor cultivation, normally devoted to nettles, brambles and rubbish, and of value only as an extension poultry-run. Like the small paddock, once exercise ground for the pony or general-purpose cob, and now 'rough pasture' full of ragwort because it is too small to plough up and reseed, this is the sort of wasted land on which Comfrey cultivation should begin.

Despite the evidence of the last chapter, there is not sufficient experimental backing from research on a wide range of soils, with long-term experience from the angles of farm economics and animal nutrition, to justify any man putting down ten acres of Comfrey on good land. There is more than enough evidence to justify farm-scale experiments to prove the value of the crop with the soil and other conditions of any particular holding. A plot of from a quarter of an acre to an acre near the farm yard, easily dunged, quickly mown and with only a short distance to cart the heavy load of fodder will do more than test the merits of the plant in any particular farming circumstances; it will provide offsets for further expansion. It is also easy to fence in and remove the crop by pig folding, at considerable benefit to the baconers, if necessary.

This type of land is often rich but inclined to be acid, especially if poultry have had the run of it for long periods. A soil test should be made to show the lime dressing required to bring it to Ph. 7.0 or above, and a further test is advisable if there is reason to believe the land to be potash-deficient. The last is important only on poor sands; on clays and loams the potash is available at levels where the roots can reach it.

Drainage needs attention, rushes and Comfrey do not go together, but the main need is freedom from some perennial weeds; annual weeds are not a problem, and bracken can be neglected. The constant cutting of a Comfrey patch will keep the crop a long way ahead of the weed, and in two years bracken will be entirely destroyed. The main problem-weed is Twitch, Couch, Scutch, False Cat, or whatever local name is used for the grass with thick white roots which is botanically *Arrhenatherum elatius*. If this is really bad, a summer dressing of Tecane, the sodium trichloroacetate weed-killer that destroys the roots completely, will leave the ground safe for planting after two months' fallow for the poison to wash out of the ground. This type of land is often full of perennial nettle, the big one with yellow roots that thrives after poultry, and creeping buttercup. A 2-4-D selective weed-killer

will clear these effectively, and on a small awkward corner it is best used in powder form such as Agroyone, which is very effective also on Creeping Thistle. With nettles, two applications a month apart are advisable.

Experiments with Tecane in 1953 show that this chemical, used at the minimum recommended strength will destroy grass, including couch and leave the Comfrey unharmed. Those who wish to clean neglected plots should contact the supplier, who will have the latest information.

These drastic treatments are needed only where the land is completely foul; they are more effective and cheaper than trying to make a good job of cleaning a really awkward corner by cultivation. With normally weed-infested land, such as neglected pasture without Couch, the procedure is simply to time the attack and use the methods which will get out the greatest quantity of perennial weed roots. The seed in the ground is of lesser importance. Where there is a danger of a plough-sole or a solid pan of any type, sub-soiling is advisable.

If the land is not a neglected but a fertile corner, it should be dunged as for roots to give the plants a start, ten to fifteen tons of farm-yard manure to the acre turned under in the autumn or spring, with any liming or potash balancing fitted in during the alternative period.

Planting and Cleaning

There are two planting seasons; September, October and November, the last month to be avoided in Scotland and the colder parts of the North Country, and March, April or May in the spring. The later periods are perfectly safe, but as the first cut comes off in April, often early in the month, one loses the first-year yield. Spring planting is most popular as it leaves a longer period for cleaning up the awkward corner when work is slack in winter, and the plants get away very fast even on the coldest clays. Autumn planting, after summer weed-killer treatment and the clear two-month period to allow the chemicals to work out, especially if Tecane has been used, is another advantage.

There is no need to prepare a fine seed-bed, the land needs to be level within reason for convenience of cutting, and in about the same condition as for planting cabbage. The procedure is exactly the same. Mark out the land one way at three-foot spacing, then the other way, and plant on the intersections, using a large hand dibber. The offsets are sections of root about three inches long, each with a growing point which should go just below the surface. The main point to watch is accurate spacing to allow for cross-blocking ; row-

crop cultivation both ways may well be needed, if not often, at least some time in the life of the crop, which should be regarded as permanent, like an orchard. They need to be firmly planted, but will recover from a great deal of rough treatment. The bare roots are, however, sensitive to frost and should not be allowed to get dry and flabby. If they arrive when they cannot be planted for some days, lay them along a shallow trench and cover with soil, or spread them out and heap straw or strawy dung over them. They should be planted 4,840 to the acre.

The plants will come away fast, resembling vigorous foxgloves, and their main need, in land that is full of weed seeds from long neglect, is not to be strangled at the start. On normal land this is a matter of horse, tractor or motor hoeing two or three times until the crop covers the ground. Though the three-foot spacing allows the best use of room and development of the finest plants, this can be varied to suit the row-crop spacings employed normally on the holdings; six or eight inches either way to save tool bar and wheel adjustments make little difference.

After the first two cuts, on good land, even without the Stephen-son system of cleaning (see page 43), row-crop cultivation is only an occasional necessity. Constant cutting makes Comfrey grow faster, few weeds will stand up to it, and the speed of growth of the crop means that it strangles a very great many seedlings, allowing few to reach seed-setting stage. When it is not growing fast, on poorer land, then row-crop machinery can keep it clean effectively; neglect it and its problems begin, and your furious letter to *The Farmer and Stock-Breeder* may be quoted a hundred years after your death.

The trial plot, with autumn or early-spring planting, should produce from 20 to 30 tons the first season, 40 to 60 the second, and 80 to 100 the third, though the fourth season may produce the biggest weight. As with any other crop this depends on the land and the season. A really dry spring and summer on a new-planted plot may hold back the yield, but once the main roots are down drought will not affect it, and even the water content of a big crop is an asset, carted to the beasts in a year of dry pastures.

The Stephenson System

This is the ideal method for cleaning the small areas on which Comfrey is usually grown, particularly where turning tractor implements is difficult. It is also very much cheaper than any of the selective weed-killers. On the pig and poultry farm where the crop has its greatest value, it makes Comfrey

the most economical of all green fodder, apart from the advantages of the heavy yield and high protein-fibre ratio.

The birds employed on weeding should be housed if possible in a wheeled semi-intensive poultry house, because they are inclined to clean very thoroughly near the shed and neglect the distant portions, so that a move should be possible to bring these areas under 'the golden beak'. This is especially useful with a long, narrow strip. They should not be turned on to newly-planted Comfrey until it is growing well and at least a foot high in case of possible damage to the first shoots, but apart from this precaution, they may stay on the land all the year round.

The normal number for cleaning is 200 birds an acre, but this is determined by the risk in overcrowding. Short periods of stocking above the normal semi-intensive limit could be employed to clear a thick crop of weeds by pecking and scratching. It will be found that some perennial weeds will get past the poultry, and this means going over the ground during the winter or early spring and digging out any stray docks or nettles; they are few because when constantly cut down their young shoots are eaten, and this exhausts them further.

No attempt should be made to sow down a poultry grass mixture between the plants, or to use a cover crop, even a legume, as a weed-strangler. The contribution of the poultry is to keep the ground dead-clean, their green fodder comes from the cut Comfrey left on the land for them, which is only a small fraction of the production. Further details of the system, so far as rations are concerned, will be found in Chapter V; ducks and geese graze the crop and are unsuitable weeders. If the birds are fed on the Comfrey land there will be little need for wire netting, either to keep them in, or to keep rabbits out; the bristly leaves will take care of the latter job.

Cutting

The first cut on a newly-planted plot should be when the plants are roughly a foot high, taking in one-thirtieth of the area the first day. This will not be a large yield, measured in ounces per plant, but by the time the ground is crossed the last plants will be over two feet, even three. The aim of this first cut is to space out the growth of the plants like the annual fellings of well-managed woodland, so that one returns to the beginning to find the plants large enough for the next crossing.



8. Part of a $\frac{1}{4}$ -acre of Comfrey weeded by poultry for ten years. The yield on this poor stony Yorkshire soil owes much to the free manuring from the birds.



9. Neglected Comfrey on good land. This plant would give about 15 lb of fodder if cut, but 8 cuts of 7-10 lb. Each would yield ore protein, less fibre and more tons an acre.

On a small scale, cutting can be by scythe, hook, beet-topping knife, or motor scythe. The usual procedure is for the pigman to take out a slit-open bag or two stitched together, and drag them after him, cutting until he has enough to carry away on his shoulders; the same applies to poultry, it is cut and carried in one journey. Where the daily cut is large enough to be worth starting a tractor and grass-mower, mechanized methods can be applied. As the fibre content

shows, it is soft and easy to cut at speed. If required chaffed, a cutter-blower would take it, but not economically on a small scale. Those who feel that such handwork is a drawback, should consider testing wheat on the same scale. By cutting rather more than has to be carried and leaving the rest to wilt until the weeding poultry are ready to eat it, their green-food supply is given with less labour cost than anything else that has to be grown and carried to them. Where the crop is not required for a daily ration, but for hay, silage or compost, the whole crop is mown at once. The first cut at between two and three feet and the others at intervals of a month or six weeks, taking the illustration from Messrs. Suttons' Catalogue as a rough guide to the best cutting condition. For compost it should wilt for forty-eight hours to lose about 50 per cent of the moisture. Gathering then is done with normal farm machinery, and though it is advisable to avoid running over the clumps with tractor wheels, they are pretty tough during the growing season. In winter all operations, especially dung carting, should be with wheels or tracks between the rows.

This daily cut system is the most widely used but others are possible, so long as the plot is cut a minimum of five times a season. Crossing in large cuts daily for a fortnight or a week to scatter on overgrazed pasture for cattle may fill a feed gap, and so long as there is enough on the plot to justify the labour cost of cutting, these cuts can be close together, especially in June, July and August. In October and November the growth slows and it will be noticed that sun and warmth are of more importance to the yield than drought or wet. A hot dry summer may mean a record Comfrey crop.

It should be realized that cutting is a real benefit to the plant and that a row left (to see how big it will grow) will no more gain fodder than would an attempt to cut June hay plus the aftermath by delaying hay-making till September. If a crop is being strangled by weeds, mow it, and turn on the chickens, or use a selective weedkiller. But even three mowings at monthly intervals will put the crop ahead of the weeds.

It is better to cut the June, July and August yields to waste or to experiment with hay from them than to leave them and risk the autumn cuts which are again useful as grazing reinforcements. All cuts should be at two inches from the ground. Cutting at least six times in the first season is almost essential for establishing good Comfrey easily—like the farm lad's first shaves, it is the early reapings that build up productive stubble for the future.

Manurial Treatment

With poultry weeding there is a constant top-dressing of nitrogen-rich droppings on to the crop just as happens with folded poultry on pasture. Including the winter period, when more time will be spent on the perches, the average amount applied to the land by 200 adult birds will be $3\frac{3}{4}$ tons per year, the equivalent of 10 tons of F.Y.M.: except for the absence of humus, and the fact that though it contains the same amount of potash, the nitrogen is increased by half, and the phosphorus is right up, the equivalent of $7\frac{1}{2}$ cwt. of superphosphate against 3 cwt. In addition, long-continued poultry manuring makes the land more acid.

Excess phosphorus has the effect of locking up the available potash in the land, and though the Comfrey roots go far below normal crop level, in poor or sandy soils balancer dressings of muriate of potash are advised. These can be from $\frac{1}{2}$ to 2 cwt. per acre, the higher figure only when poultry manure is used exclusively on potash-deficient land. On good deep clay or loams it may not be needed for years, but on land that has been used for poultry before planting for a long period, or a hungry sand, a soil test by the County Horticultural Adviser well repays the trouble of calling on his free services. He will probably know nothing about Comfrey, but he can determine how much is needed to put the land into a fit condition for a good potato crop, and save wasting lime if the soil is still approximately neutral.

The high ash content of Comfrey, approximately 14 per cent of the dry matter, is 35 per cent potash, 14 per cent calcium and only 5 per cent phosphorus, so it is easy to see where the load comes. This explains both its quality as a compost maker, and the failure on land 'where nothing else will grow' when the failure of previous crops has been due to serious potash deficiency. Apart from this, poultry manure, with its high nitrogen content, is ideal.

The general routine at the end of the season should be lime and potash if required, on the surface and worked in between the rows with a cultivator, called a 'scuffle' in some districts, about late November after the last cut. In February or early March before the shoots are up, F.Y.M. or poultry manure again, and scuffle it in. The remainder of the cultivations and manurings are left to the poultry.

Where poultry are not employed as weeders, a summer dressing (about June, when the crop is growing most rapidly) of F.Y.M. or pig manure is advisable, the amount in all cases depending on the fertility of the land and the growth of the crop. Sewage sludge can be used, but as this is still lower in potash, the balancer need will be rather more likely to occur.

The vast crop of seedling tomatoes that this will produce from a summer dressing are not poisonous to poultry, but they may need a scuffling to kill them if they grow ahead too fast.

Nitrogen deficiency may occur, in areas away from the poultry-run especially, and because this is the key material for the intense production, it should be corrected at once. It is shown by reduced growth speed and yellow-green foliage, as distinct from the normal healthy dark green. It can be corrected by organic manures, or by nitro-chalk, as the by-product of this is calcium carbonate; both sulphate of ammonia and nitrate of soda have been used with poor results, but there is little real evidence. In theory nitro-chalk is best; it has worked in practice, and only a modest scattering is required.

Comfrey Cultivation on a Large Scale

The three main maxims for successful Comfrey growing are: 'keep it Clean'; 'keep it Cut'; 'keep it Fed'. These apply on all scales, and when the crop has proved itself on any particular farm, its extension to a larger area is purely a matter of performing the same operations more cheaply because of the advantages of mechanization. The remaining section deals with further problems that could arise also on the trial plot, but are more likely with a bigger area.

The selection of the site needs greater care because wherever it is planted it must stay, like an orchard; its cost of establishment in money or labour is high, and its extermination, though possible, can take the land out of cultivation for a considerable period. Those who have secured a yield of eighty tons an acre or above, and who are convinced of the advantages of this crop, have also to consider distance from where it will be fed. Its yield, like lucerne, is in several cuts, but with a greater weight for a longer period, and six 15 to 20-ton cuts mean considerable cartage. Cutting as a 'last job' of one day, and overnight wilting for mid-morning haulage, save 20 per cent of the weight, and this applies also to large cuts for silage. Water is costly to cart, but it must get into the milk and the meat and the eggs somehow, and supplied in the fodder it has its advantages as well as its disadvantages.

As the poultry-weeding system has only been tried on one farm on a small plot (though for ten years since its accidental discovery) the problems of multiplying it up to large areas are a matter of experience to be acquired from the trial area. It is possible that deliberate gaps in planting in the centre of an area would enable houses to be towed on for occasional moving as required. A long strip, with poultry houses on the

headlands, promises less interference with tractor work, cutting lengthways only; with poultry in use, the need to cross-block does not arise, and so all turning could be on the short dimension away from the huts.

It is possible that with increased experience of selective weedkillers spraying or dusting by contract or direct labour would prove more satisfactory on areas over five acres. On better land with easier working it is even more likely that row-crop cultivation between cuts, combined with the swift growth of the plants, would do all that was needed, coupled with reduced germinations from the shallow cultivation that leaves the charlock safely underground.

Despite all that has been said in this chapter concerning weeds, Comfrey is no more likely to be infested than any other crop. The importance of their control arises because the land cannot be ploughed up for a fresh start, and in ten or even twenty years perennial weeds accumulate.

Increasing Comfrey

With every crop it pays to plant the best variety for market and soil. With Comfrey there are no varieties, as we have seen, merely three variable species and their blendings. There are, however, strains which are producing heavy weights on present-day holdings ; increased vegetatively they contain the best of those grown in the past. It is possible that by the time the sceptic has had his trial plot three years, selected strains may be in the course of development, but this will be a long job, involving their proof under a wide range of conditions for at least five years. Therefore his trial plot which has produced enough to justify the expansion can provide the offsets for it at a saving in cost, for though the labour involved has also to be paid for, one is cutting out carriage and the sellers' overheads and profits. It is also, on men's time alone, far cheaper than hedgerow gatherings, of whatever combination of genes may 'joy in watery ditches' in your district.

The farm method of increase designed to multiply a quarter-acre trial plot to three acres or perhaps four or even five according to how well the plants have grown, is best carried out in March or April, as soon as the plants can be seen starting into growth. Take a beet-lifter along the rows, to cut the roots about six inches below the surface, first one side and then the other. Then lift them from the soil by hand and cart them off to a shed or barn where they can be cut up, with sacks spread beneath the cutters. They should not be cut up on the land as the fragments will fall between the

rows, and make any row-crop work in the future almost impossible.

Slice the roots into fragments, each consisting of a growing point and a length of the brown or black rootstock from three to six inches long. This may be cut so that only a third of its outer surface is original bark, like slicing seed potatoes, and memory of the original offset is a guide to size; but it pays to be generous with yourself, as greedy slicing means misses in the row. If growth is advanced the foliage should be trimmed back to about an inch of stalk; there are plenty more leaves where these came from, and they are a handicap to the young crowns when first planted because of transpiration.

The broken fragments on the sack and the soil with them should not be thrown on the land, they will grow all the more strongly where not required. Feed them to the pigs, to the delight of this stock; at present prices Comfrey roots are too costly in labour as feed, but they are safest in the trough. Before the synthesis of Allentoin there was a demand for the roots for medical purposes. The late Kenneth Crawley was asked several times to supply by the ton, but their value as fodder producers was too high to consider even the best offers. These broken fragments will grow, but they are not suitable for field planting.

The best time to carry out the operation is in the third year; either the spring following the big cut from fully-established plants, or in the autumn about October, after a cut. Lower yields of offsets will be secured in the second year, after the first year still fewer, and as it is a handwork job, it may as well be done when there will be enough increase to make a single big planting.

The trial plot is probably in a place which will produce nothing else in the way of a crop, and in the most convenient position for feeding stock in the yard. It is therefore desirable to keep it as a Comfrey corner even though its production may be a fraction of the whole. It is also useful as a producer of any further offsets required without interfering with the main area, and being near the buildings, it can be fitted in as a wet-day task.

On this small scale the best method of levelling-off is to go over the rows with a fork as though digging headlands, fill in the holes roughly, and leave it to the poultry and the normal routine. Do not on any account plough it, because the small broken fragments of root at this season will grow as small-scale weeds all over the place; in March no tillage operation can kill those super-dock fang roots. The first cut will be through late, while the buried roots thrust up sea-kale like

shoots through the soil, and green-stuff may need carting to the birds. By June they will be through and growing with almost the old vigour, but each plant will be wider in area. A further plough-up in another two years will produce even more good offsets, but spread them still further and this may mean so much difficulty in cultivation that the crop is better got rid of for a fresh start. This depends on how it is growing, but if the yield falls below the fifty tons a season, either it is under-manured or past its best.

Exterminating Comfrey

The simplest method for a small area is undoubtedly the one used by German smallholders and peasant farmers, who grow the crop for pig feeding on a rotation that includes destroying it after from five to ten years, as though it were a temporary ley. They wait until May when the first cut is really tall, about four feet, and turn on the pigs unringed. These stay until October, replaced according to the usual routine of the farm; they eat every fragment of crown and snout up the shoots that spring from the buried roots until these are exhausted. If the ground is hard, plough and cultivate, and the snouts will look after the fragments. The pigs cannot be expected to fatten on this diet, though the first lot, with the fodder of the full crop to tackle, get a great deal of benefit. They must be fed, the roots are simply a titbit of which they are extremely fond. The odd trial corner, whether it has just been used for offset production, or if it is desired to give up growing the crop as a failure, or if it is unsuited to your land or conditions, should be wired in and used as a pig run. The ploughing to allow further snouting is best done after the land is already cleared of foliage; by cutting deep, a great many can be brought to the surface. A trial with ringed pigs on a normal Comfrey patch, even by accident, will demonstrate the efficiency of this method; even ringed they can do a great deal of damage.

Large-scale extermination is better effected by exploiting the 'resentment' of the plants at winter disturbance. Plough not in November even, but in December or January. If there are large roots, as from a good well-grown field (an agricultural folly), take up the main clumps for pig-feed as if they were mangolds. Leave the ground rough and let the frost get at the roots; deep ploughing at this time of the year not only kills the exposed roots, but the broken ends rot in the land to a considerable extent. The efficiency of the kill depends on the plant; our native *S. officinale* is the most resistant, and *S. peregrinum* the most easily destroyed.

Nearly two and a half acres of Comfrey were removed on the late Kenneth Crawley's farm, after his death, by the then owner. The large roots were carted off and fed to pigs, for by this time these were almost as weighty a crop as turnips, and after leaving to the frost, the land was sown down to a ley. It was grazed by sheep and these animals, though slower as exterminators, completed the clearing of stray fragments in two years without damaging the pasture as rooting pigs would have done. These sheep were accustomed to Comfrey, and it would pay anyone troubled with the *Symphytums* as weeds to gather enough to feed wilted to give them a taste for the plants.

Orthodox methods of ploughing, harrowing, cultivating and even picking up by hand in spring, summer or autumn, when the plant is growing, merely spread it still wider and leave more 'root cuttings' to struggle on as weeds in grassland, or indestructible monsters whenever a well-manured arable crop is grown.

Selective Weed-killers

The application of selective weed-killers to Comfrey has as its basis the experiments undertaken by Messrs. Pest Control in conjunction with the National Agricultural Advisory Service (Eastern Province) to clear a field infested with a hybrid of *S. officinale*, an almost clear, pink-flowered form, that seems capable of setting more seed than the others. They found that nothing they had would destroy it; the only thing that seemed to hold out hope was repeated strong sprayings with 2-4-D. Unless something extremely powerful can be discovered, it is unlikely that selective weed-killers will be able to compete on cost with pigs or winter ploughing.

This failure opens a whole field of experiment to discover what strengths of which of the selective weed-killers can be used to clean up, as easily as a modern wheat crop, Comfrey that has got full of perennial weeds. The writer used 2-4-D at the standard strength recommended for lawns; the foliage twisted but the plants soon grew past it, and after a rather poor cut, the next was as good as ever.

The difficulty was that the grass survived, and grass in Comfrey is as bad a weed as any other. A likely killer is T.C.A., inorganic salts of trichloroacetic acid, which destroys grass and is used in America for weeding raspberry canes. It is very difficult to balance the application time and strength to avoid killing the fruit, but Comfrey has a far higher safety factor. MCPA is another substance which will not kill Comfrey, and Messrs. Pest Control suggest this in the form of Phenoxylenes 30 at one-third to two-thirds of a gallon an acre;

or Phordene at 2-4 pints, diluted according to instructions. The last is 2-4-D and also therefore safe.

It is possible that T.V.O. or other oil sprays may be the answer, and in any event small-scale trials with spray or powder should precede any larger application until more is known. One thing is certain, the marvels of science cost money, and it is likely to be very much cheaper to keep Comfrey clean by chickens, cultivation, or its own growth vigour on really good land, than to let it get into such a state that chemical assistance is needed. Selective weedkillers, however, are among the many possibilities that give this crop very different prospects in the future.

The Elderly Comfrey Patch

The yield of Russian Comfrey increases steadily until it is between five and seven years old, but at ten years after planting it begins to go back, a decline that varies with the soil and manurial treatment. The main roots die of old age and rot off in black decay, while the growing points on the outsides spread into a kind of 'fairy ring' or 'moon crater' of vigour, with a bare hollow in the middle. There is a greater tendency to run to stem and flower, and the plants are much more difficult to row-crop and cut without running over the crowns.

As an alternative to ploughing out in winter, or using pigs, or a combination of both, the plants can be drastically reduced. After ten years, three-quarters of the area of each plant can be dug up, taking the circumference of the circles so that smaller clumps are left at reasonable intervals for cultivation. The offsets from these will grow to full vigour when replanted on fresh land, as the operation is essentially the same as dividing an elderly Michaelmas daisy in the garden. The land is then well dunged and scuffled between the rows and plants, and with steady cutting the roots regain strength and the yield is restored.

This expedient has been tried on the Little Weighton patch, and the revenue of offsets from the process is extremely valuable. It is the only way by which they can be secured without the dip in yield from digging or ploughing up the crop, and the only means by which good Comfrey growers will sell stock that has stood the test of years. The decision whether to renovate or replant depends on how well the crop is doing, and the advantages of the site for handling. As yet there are no comparative figures to give the economics of keeping a plot down for twenty years or so, and grubbing on rotation with pigs on the German system.

Pests and Diseases

The Comfrees have no insect pests; the records of the Royal Horticultural Society Entomology Department reveal no instance of these plants being attacked by anything during the long period covered by the Host Plant Index at Wisley. To this vacuum can be added immunity from rabbits, and a further blank for such birds as wood pigeons which are repelled in the same way as rabbits by the bristles of the growing crop.

There is, however, a disease, the rare Comfrey Rust, which is found on the wild *Symphytum officinale*. This is *Melampsorella symphyti*, which has been reported from France, Finland, Central Europe and possibly Sweden, with one case on *Omphalodes lusitanica* in Spain. An account will be found in Groves's *The British Rust Fungi* (Cambridge University Press 1913) and a French textbook *Les Champignons Parasites des Plantes Cultivées* by Viennot Bourgin (1949). Further references are: *Transactions of the Botanical Society of Edinburgh*, Vol. 21, page 426, and *Proceedings of the Royal Irish Academy*, Vol. 42, page 49.

The fungus resembles very small butterfly eggs occurring as dark yellow or orange patches on the underside of the leaves, the stage in its life history known as the 'uredospore'; its previous host is the Silver Fir (*Abies albe*, syn. *A. pectinata*). As neither host is common, and both together within infection range even less so, very little is known about this Rust. One case only is known of it on *Symphytum peregrinum*, none on *S. aspernum*. In this one instance it appeared (on twelve leaves in all) on plants starved by nitrogen shortage into a bad condition. The treatment recommended by the N.A.A.S. mycologists is to burn straw on the plot in winter after the crop has gone down, in the same way as one would for the Peppermint and Mint Rusts which are far more common.

If greatly extended Russian Comfrey plantings (no record of the rust appears in the 1870's and 1880's) bring this rare fungoid disease in areas where *S. officinale* or *S. tuberosum* (on which it was observed in Germany by Fischer about 1903) and the Silver Fir are both common, this Rust would be a problem. However, the strength of Russian Comfrey is such that very powerful fungicides could be employed to destroy the Rust.

The writer is indebted to Dr. G. R. Bisbly of Kew, Miss June Ives of the N.A.A.S. Mycology Department, and the Mycology Department of the R.H.S. at Wisley for this information on what is almost a collector's piece among rusts. There is also one report of a powdery mildew, *Erysiphe*

polygoni, and four other fungi that attack *Symphytum officinale* which are listed in *Diseases of Plants* by Tubeuf and Smith (1897). So far as the farm is concerned, pests and diseases are merely a possibility of the future. A virus of Comfrey has been discovered in 1953, the spotted wilt of tomatoes, but this is equally rare.

Feeding and Utilizing Comfrey on a Farm Scale

The grazing of Comfrey with any stock is not recommended, because with grass available in a mixed pasture, the conservatism of most beasts will give rise to the old problem that 'no stock will eat it, if they can get anything better'. This of course applies to normal hay and silage. With dairy nuts in the milking parlour manger any cow will select a diet which is entirely uneconomic; in human beings, rice pudding in youth and (perhaps) water as a drink for some adults, are comparative examples.

Tethered beasts will eat Comfrey readily, but the tether should be moved before they crop it within three inches of the crown, and if stock is on the land in winter great damage will be done. Folding Comfrey on an 'on and off system' with electric fencing would be an ideal method of cashing its yield, possibly with poultry to follow and clear up the waste plus harrowing. Problems would arise from the heavy dunging in a small area; after kale, what would be a heavily stained pasture dressing of fresh cow dung is turned under. With Comfrey, the stock would be back in from four to six weeks, and the instinct to avoid land freshly dunged in grazing beasts springs from the desire to avoid intestinal worms. Cultivation between cuts might cure this, but too little is known about folding Comfrey for any recommendations to be given. In the 1870's and 1880's folding with hurdles was carried out with the arable flocks of Southdown sheep, but on chalk lands unsuitable for Comfrey. Accounts of grazing are so conflicting that the only advice can be to try on a clean crop of *Symphytum peregrinum*. No one knows definitely either way, and the reduction in feeding costs would justify extensive experiments, not a single half-hearted trial.

Large-scale Cutting

The daily cut of Comfrey is a problem, but methods applied to lucerne can reduce the labour cost. It is very much easier to harvest ; the leaves are larger and the stems longer so that a buck-rake can be employed. The following method is suggested by the Ferguson Tractor Co.

Cut a daily strip two rows wide, running the tractor with the wheels each side of the last row of the previous day's harvest, and the six-foot mower-knife set to work between two and three inches from the surface. Turn on the headlands and either come back through the crop (up to a week's growth can be run through without leaf damage, even on a good crop) or take in another two rows on a wider strip. Then remove the cutter-bar and fit the buck-rake (a ten minutes' job with a Ferguson, and on a daily routine with the right spanner handy this could be reduced) and back in for the first load, which is about 7 cwt. for material of this sort that rides easily. Because of puddling the ground on a heavy clay this would be awkward in heavy rain, but with a fitted cab the weather problem would not affect the one man on the job. Two men with a horse and cart, scythes and forks every day are a very different matter at modern wage rates.

It would be found in practice, as on a smaller scale, that some of the cut gets left, though less than with most fodder crops. The driver could judge this by eye and aim at leaving sufficient for the cleaning poultry, with a sharp hook hung beneath his tractor seat to cut another few plants by hand if necessary. The really keen labour-saver would rig to the front of the tractor a detachable hopper to carry the grain or pellet allowance for the birds, opened to a trickle by a string or lever from the driver's seat. On the last load this feed would be scattered over the cut green-stuff, and would make sure that every strip was thoroughly scratched over as it was cut.

This is purely theoretical: a buck-rake will pick up Comfrey clean, but no one has ever grown a big enough patch to gain the saving from mechanized cutting and delivering to wherever it is to be fed, several tons of this feed a day in a shorter time than most fodder crops because of the bulk from a small area. Where wilting is required the job would need to be done in two halves, ideally the last job at night, cut with the mower; the first job in the morning is to go out with the buck-rake and gather it.

Russian Comfrey Hay

Very little hay has been made with Comfrey, partly because of the small areas grown but mainly because of the idea in the 1870's and 1880's that a plant so bristly would be uneatable dried. This arises from a misunderstanding of the nature of the bristles. These are very light and flimsy structures made largely of silica, securing fragile stiffness on the same principle as wheat straw and explaining the relatively high proportion of this element in the ash. They are rigid because they are filled with water which exudes through

their tops at times, as a fire hose is stiff with the inward pressure. Fig. 5 is a drawing through a high-powered microscope of a leaf spine of *Symphytum peregrinum*, and Plate 14 a microphotograph of leaf and empty bristles.

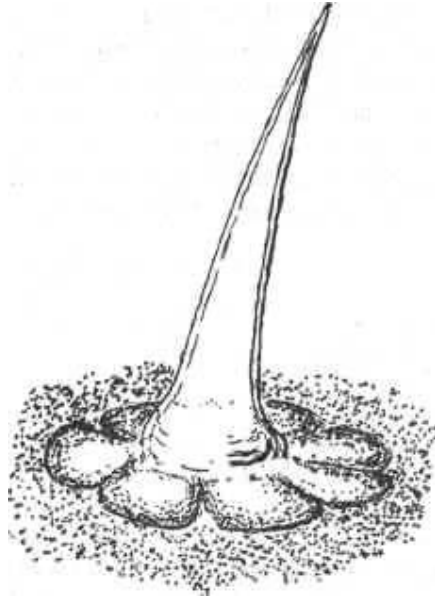


FIG. 5

Leaf bristle highly magnified. Unlike a rigid thorn this is a very thin shell of silica kept stiff by the liquid inside. Emptied by the wilting leaf, it sucks flat and smashes

When Comfrey is first cut it is still transpiring at its normal speed, and the first wilting is extremely fast; in an hour 88 per cent moisture has become 78 per cent. The water drains out of these bristles back into the leaf, and the empty shells are so frail that they are not even capable of repelling tame rabbits once these tender-mouthed animals are used to the fodder. Comfrey hay is simply the wilted product carried on till it is dry enough not to heat up in the stack, and it is regarded by many as the best form in which to feed it.

With hay the great problem is to hang on to the leaf, because it is the grass 'leaves' that go brittle with drying in the sun, break off when the crop has to be turned and returned in catchy weather, and stay in the field, leaving the fibre to come in the carts. It is an old saying that hay is the only thing that is best cheapest; the low labour cost crop made quickly in perfect weather brings most of its nutriment into the stack. Nearly all hay crops are small and brittle-leaved, even clover and lucerne, so Comfrey, as the biggest-

leafed hay crop, has an unfair advantage in the strong vein system that holds these together rather better despite rough handling.

This is shown in the following analysis figures:

| | <i>Crude Protein</i> | <i>Starch</i> | |
|--|----------------------|-------------------|-----------------|
| | <i>Per cent</i> | <i>Equivalent</i> | <i>Fibre</i> |
| | | <i>Per cent</i> | <i>Per cent</i> |
| Meadow Hay leafy stage | 13.7 | 49.3 | 19.5 |
| Meadow Hay flowering stage | 7.6 | 35.6 | 28.7 |
| Meadow Hay seed set, full flower | 4.8 | 32.5 | 30.6 |
| Lucerne Hay before flower | 16.4 | 32.2 | 27.3 |
| Lucerne Hay full flower | 14.5 | 27.1 | 30.0 |
| Russian Comfrey leafy stage | 24.4 | 44.1 | 13.5 |
| Russian Comfrey flowering stage, Stemmy | 10.3 | — | 18.1 |

The first figure for Russian Comfrey, so far as is known *S. peregrinum*, is from 'The Science and Practice of Conservation of Grass and Forage Crops' by Dr. Stephen J. Watson (*Fertilizer and Feeding Stuffs Journal*, 1939). The second is from an N.A.A.S. analysis of hay made by Mrs. P. B. Greer of Layer-de-la-Haye, Essex, in August 1952. The first figure shows the lead over lucerne of 8 per cent on protein and nearly 8 per cent starch equivalent, with only half the fibre, which Comfrey has. Lucerne hay has often been described as 'high-protein roughage'. Comfrey hay is well ahead of the best meadow hay on protein, but with less starch equivalent and very much less fibre.

As the laboratory very often merely confirms manger tests by the consumer, it is interesting to note that Mrs. Greer, who has probably been the first Comfrey hay-maker for twenty years at least, has fed it and gives the following report: 'Goats smell it and nose it but eat it ravenously once they have got over their distrust. The five-months-old calves were just the same, at first suspicious and then clearing up every bit of it. My old sow eats it straight away without any hesitation and the little pigs, seven weeks old and still suckling, eat it up with relish.'

The main problem with Comfrey hay is the thick mid-ribs of the leaves and the stems which may be an inch in diameter. These retain their moisture long after the rest of the crop has dried, and with perhaps fifteen tons an acre lying on the land, the mass of foliage is inclined to mat together. This is partly overcome by cutting at a very leafy stage so that the main stems are few, but though the first 20 per cent of moisture vanishes rapidly and the next 30 per cent with almost the same speed, reducing the plant to the

stage at which it is used for compost, the further drying to make it into hay is more difficult.

The quality of the hay is so good that it is worth using the Highland crofter's system of tripoding. These tripods of stout stakes about four feet long, or the metal type now available, are used to make hollow-centred haycocks, heaping the wilted material round them to complete drying: by the natural draught up the middle. While this system is costly in labour and is popular only where heavy rainfall makes it the only way of making hay at all, and the only possible way of saving some of the protein and carotene, the bulk of the material available and its nutritional value make it a paying procedure for this crop. It is possible that artificial blowing in the barn, with warm or at least dry air, on the lines of the modern sack-grain drier, would repay experiment as a method of extracting the last and most resistant moisture.

The small 1952 plot was cut by hand and good weather enabled the crop to be dried completely in the field by normal methods, even the solid stems, as this was *S. peregrinum*, very near Henry Doubleday's original. It gathered cleanly and was far less trouble than anticipated. In Mrs. Greer's view a succession of hay-makings, with the odds on at least one out of six being quick and easy, would be one of the best ways of utilizing the crop on a smallholding. The successive cuts could be stacked in a dutch barn, and each individual cut would be rather larger than a normal haymaking.

Silage

Silage is another obvious use, but here the need is to avoid the problems of high moisture and high protein but low carbohydrate, with the difficulties that these have caused in the past. Twenty-four-hour wilting is advised to bring the cut down by 30 to 50 per cent of the water content, not only to save drainage in the silo, but to avoid carting water from the field. The N.A.A.S. advise that two gallons of molasses mixed with a further two of water is the minimum ; three gallons was rather better to make sure of a good lactic acid fermentation and the fall in pH value after heating that keeps the crop in a state of arrested decay. It is not the purpose of this book to deal with silage-making when the process is fully described in standard textbooks, but the key to the process is the fermentation of carbohydrates, and this is why legume cereal mixtures and green maize, among crops grown for this method of preservation, require no added molasses. Comfrey, with the protein higher than any, but low in carbohydrates, needs the addition; if too little is added the proteins will not be preserved and their decay will make the

whole product ill-smelling and distasteful to stock, apart from lost nutritional value. In this case the blame lies with bad silage-making, not the crop.

The silo should be filled loosely and the first four feet should go in totally unconsolidated and allowed to warm to blood heat before the rest of the crop is filled in. There should be some drainage provision as there will be a loss of liquid, but not on any great scale if the crop is well wilted. There is no need to chaff it, as unlike other stemmy materials the fibre is low and the stems break up; twenty-five tons of maize, as an example, contain over a third more fibre than fifty tons of Comfrey. Nor is there any great range of analysis figures giving sufficient comparisons to show if there were better or worse Comfrey silage makers. The one we have by this method shows 17.69 per cent fibre, 17.7 per cent crude protein, 14.37 per cent digestible protein, and 14.69 per cent ash. This brings it very near good grass silage, but unfortunately the starch equivalent is not recorded, so full comparisons cannot be made.

Dr. Stephen J. Watson, in his experiments with silage at the I.C.I. Jealotts Hill Research Station, made some by the A.I.V. process, using *Symphytum peregrinum* so far as is known. His analysis is as follows, with other materials calculated on the same dry-matter basis from the Ministry of Agriculture Bulletin 48:

| | | | Nitrogen-free | | | |
|-------------------------|----------|---------|---------------|----------|-------|-------|
| | | | Ether | Extract | | |
| | | Crude | Extract | (carbo- | | |
| | Moisture | Protein | (oil) | hydrate) | Fibre | Ash |
| All figures in per cent | | | | | | |
| Comfrey Silage | 79.20 | 22.42 | 2.72 | 42.68 | 19.85 | 12.35 |
| Maize (green) | | | | | | |
| Silage | 81.05 | 8.65 | 4.32 | 78.60 | 40.60 | 7.60 |
| Kale Silage | 84.10 | 12.60 | 3.14 | 45.40 | 23.10 | 15.60 |
| Cereal-Legume- | | | | | | |
| Silage | 72.70 | 12.45 | 4.38 | 45.60 | 29.30 | 8.05 |
| Good Grass Silage | 79.00 | 18.10 | 4.76 | 47.20 | 20.40 | 10.00 |

To quote their report: 'The Prickly Comfrey made a good silage of high protein content. The breakdown of proteins was not excessive and the material was eaten readily. According to the textbook, prickly Comfrey silage is usually disagreeable in odour.' The reason for this last remark is because all the textbooks are quoting from the remote past, before either molasses or A.I.V. silage-making were discovered. In agriculture, the figures that men use live after them, their practical farming background is oft interred with their bones. The A.I.V. process, which consists of adding a

solution of acids to the material and by-passing the need for lactic acid fermentation, is more popular on the Continent than in Britain because of the precautions necessary in handling sulphuric and hydrochloric acid. It is patented and called after its inventor, the Finnish investigator, A. I. Virtanen.

The easiest way of using unwanted summer cuts of Comfrey to help winter keep is as an addition where silage is already made. Up to 25 per cent of the fill with grass, cereal-legume mixture or maize can be Comfrey, either chaffed or as cut, and the result is excellent, with no special precautions or variation in technique. The carbohydrates in the crop balance the excess protein and the finished product is balanced at a higher level of quality. Most successful Comfrey silage is made in this way, because small plots have rarely enough to fill a silo alone; the exact proportion to secure the optimum protein increase awaits experimental determination. Mr. J. W. Hobbs, of the Great Glen Cattle Ranch, Fort William, put the first-year production of his 1½ acres of *Symphytum peregrinum* through a chopper blower and mixed it with the mashlum (cereal-legume mixture in England) silage on his Torlundy Dairy Farm. His analysis (by the North of Scotland College of Agriculture) showed a rise in protein from 10.08 per cent to 14.57 per cent, and an increase in dry matter from 16.14 per cent to 20.1 per cent at a Ph value of 4.5. Grass silage protein, from the high tonnage of mashlum, is the aim, and further experiments with a bigger Comfrey area are in progress to find the maximum enrichment and dry matter gain.

Russian Comfrey for the Crop Drier

One of the problems of using dried grass as a substitute for imported concentrated feeding-stuffs is the high proportion of fibre, and this is of special importance in pig and poultry feeding. Mechanical methods of removing the fibre have been suggested and developed, especially in the United States, but as these involve a loss of tonnage in the discarded material which has taken fuel to dry it, apart from handling costs, it is likely that Russian Comfrey meal may be of importance in the future. Though dried grass meal is a valuable source of vegetable protein and beta carotene, the last as a means of adding Vitamin A to poultry food, between 7½ and 10 per cent is the maximum that can be added to the mash because of the high fibre.

The Hannah Dairy Research Institute meal analysis (see page 46) shows 22.7 per cent protein to 10 per cent fibre and 400 mg. per kg. of carotene, which can be compared with

average dried grass having 13 per cent protein, 25 per cent fibre and carotene sometimes as low as 80 mg. per kg.; 366 mg. per kg. is really good dried-grass carotene. The unit is microgrammes per kilogramme, and 'parts per million' abbreviated to 'p.p.m.' is another unit.

Messrs. Wissington Estates used stemmy material in flower, not leafy foliage as at Hannah, and by wilting and the use of the shredder they overcame the difficulty of the thick midribs and stems being still damp when the leaves were overheated. This problem has defeated all other attempts to dry the crop, but it is no more difficult than any other, when you know how.

The following comparative table is from commercial analysis figures of crops dried that year, the grass is from pedigree leys and very far from average. The balance in each case is unevaporated moisture.

| | <i>Protein</i> <i>Per cent</i> | <i>Fibre</i> <i>Per cent</i> | <i>Ash</i> <i>Per cent</i> | <i>Oil</i> <i>Per cent</i> | <i>Carbo-</i> <i>hydrates</i> <i>Per cent</i> | <i>Beta</i> <i>Carotene</i> <i>parts per</i> <i>million</i> |
|-----------------|-----------------------------------|---------------------------------|-------------------------------|-------------------------------|---|--|
| Russian Comfrey | 21.80 | 14.00 | 13.60 | 2.10 | 37.40 | 122 |
| Beet Tops | 16.23 | 11.18 | 9.44 | 0.93 | 48.92 | 14 |
| Dried Grass | 24.80 | 22.20 | — | — | — | 438 |

Further comparative figures (from Agriculture by Sir James A. S. Watson and James A. More) are:

| | <i>Protein</i> <i>Per cent</i> | <i>Fibre</i> <i>Per cent</i> | <i>Ash</i> <i>Per cent</i> | <i>Oil</i> <i>Per cent</i> | <i>Carbo-</i> <i>hydrates</i> <i>Per cent</i> |
|---------------------------------------|-----------------------------------|---------------------------------|-------------------------------|-------------------------------|---|
| Dried grass, early flowering stage | 12.1 | 22.4 | 9.0 | 2.2 | 42.3 |
| Lucerne, early flower | 16.2 | 24.5 | 10.2 | 2.4 | 37.7 |
| Lucerne in bud | 22.3 | 18.0 | 11.4 | 2.9 | 36.4 |
| Clover meal | 10.5 | 26.4 | 7.6 | 1.4 | 44.1 |

The variations in the protein-to-fibre ratio were according to the stage of cutting for the other crops and the carotene differences between the two Comfrey samples show the importance of this point, apart from any difference of species. Dried grass varies between almost equal quantities of protein and fibre to twice as much of the latter, Comfrey between one-third less protein than fibre, to under half as much, with beta carotene in very nearly the same proportions, according to cutting stage.

The Wissington experiment was not repeated, nor were further trials carried out to decide how far the rapid wilting could reduce the amount of fuel needed to remove the additional moisture in the sappier crop. Just as at the Hannah Dairy Research Institute, the crop dried very brown,

and as the crop-drier was producing material for sale this made further production non-commercial rather than uneconomic. Grass meal sells on colour and analysis, and Comfrey meal has all the disadvantages of a black ice-cream. It may be good, but without an indisputable proof of its quality and time to build a name for itself on its merits (or demerits), no one would buy it. We do not know the effect of concentrating the Allantoin, but as this causes no trouble when fed as hay, this is unlikely to be a difficulty.

Unlike short grass and other crop-drier raw materials available in summer, Comfrey can be wilted without loss of nutriment and still be picked up cleanly by mechanical handlers, where grass blades crisp and break until the advantages of the system can be lost, as with hay. Forty-eight-hour wilting giving lower losses in the shredder from expelled juices and lower fuel cost is possible, with a midday gathering to evaporate the dew from the crop lying in the field like a quick two-day haysel.

The most promising development is hay made on the system described on page 88. With the corrugated iron slope covered about two inches deep and a single turning the product can go straight into the hammermill when the stems are dry enough to snap like sticks. The result is a meal resembling normal vegetable meal, but with low fibre to suit pigs and poultry. Analysis figures in the bad hay season of 1953 are:

| | <i>Protein</i> | <i>Fibre</i> |
|---------------------|-----------------|-----------------|
| | <i>Per cent</i> | <i>Per cent</i> |
| Sample 1. Yorkshire | 25.2 | 14.4 |
| Sample 2. Yorkshire | 21.51 | 19.7 |
| Sample 3. Kent | 22.15 | 11.4 |

The variation is partly due to the cutting stage. The capital cost of a dummy shed roof with the eaves about a foot off the ground is lower than an orthodox grass drier, no fuel is used and though large scale applications need further experiment, there is enough potential profit in 16 tons an acre (at grassmeal moisture) of meal in the highest price range to justify commercial development.

CHAPTER IV

Russian Comfrey for Grazing Animals

Beef and Dairy Cattle

The late Kenneth Crawley estimated that the ideal ration of Comfrey for dairy cows in milk was half-cwt. per day as wilted fodder or as silage in winter, to provide for maintenance and first two gallons. This was from his own experience with Ayrshires, and he calculated from Henry Doubleday's figures that the 80- to 120-ton yield of an acre of *Symphytum peregrinum* should produce the greater part of the feed for nine cows from this area, an extremely heavy stocking even allowing for dry beasts, replacements or 'followers', and the bull, to bring down the total.

The question for the dairy farmer is one of profit per cow and it is certain that the most cheaply produced feed is the good grass that the digestion of the animal is designed to take. An economic milk yield needs reinforcement by concentrated feeding-stuffs at both ends of the season, and it is here that the crop can produce savings by the replacement of part of the bought or home-grown feeding-stuffs with more cheaply produced fodder.

By the time it is eaten, Russian Comfrey is down to about 75 per cent moisture, approximately lucerne protein and carbohydrates, and the 77 mg. per kg. of beta carotene in the fresh leaf is up to 155, because there is less water with it, until this is approaching that of fresh summer grass. We have abundant evidence from the past (especially from the Rev. F. Gilbert White) that there is enough to increase the butter fats in the early spring. There is also complete agreement between past and present that fresh Comfrey has never caused bloat or hoven even when eaten in quantity.

The most useful routine, practised by those who still feed it to cattle, is to take the early cuts quickly. If keep is short when the plants are merely a foot or eighteen inches high, cut and scatter it on the pasture where the beasts are for the 'off period, of modern ley grazing, or on the one that has little feed on it. A mild winter will start Comfrey early and it 'gets rich' more rapidly than grasses because it is growing from stored nutriment in the root. Crossing the plot in a week may fill a feed gap and a second cut after a short interval may well pay, especially in a dry spring. Even a third may be of value, and this treatment is a real benefit to the crop once it is established, or even in the second season. The aim is not to

produce a record or disprove a claim, but to take the crop at the period when its nutritional value has an advantage over grass, and the smaller cuts with mechanized methods are more useful than a few big ones when there is plenty of feed. It will be found that cattle of all ages will always eat some wilted Comfrey each day however good their grass, in the same way as they will go to the hedges for deep-rooting herbage, for a change and to supply minerals, in this case probably calcium apart from trace elements from greater depths.

In June and July when Comfrey is growing at full speed, grass is plentiful, so the cuts at this time should go for hay (in exceptionally good weather, or with tripods), silage, or to other stock. In a dry year when grass quality falls rapidly, the drought resistance of Comfrey provides full-sized cuts to reinforce the pasture. The aim should be a really good stand for the October or November cut when feed is getting short, and at this end of the season it can be allowed to get big and stemmy. This does no harm to the crop the following year and may allow as much nutritional value as a twenty-ton marrow stem kale crop to be held until it is needed. The advantages will vary from farm to farm and season to season, as production of Comfrey varies little, and its lead on other fodder crops and grass depends on how these are affected by soil and weather.

Cattle need to be accustomed to Comfrey, but this is not difficult. It can be fed chopped or chaffed with the concentrate ration in the milking parlour, or merely scattered on the pasture to wilt until it is cleared, feeding always in small quantities at first. The curiosity of cows is sufficient to solve this over-emphasized problem in about a week. Silage presents no difficulty, it should be fed like any other type, and the Ministry of Agriculture pamphlet 'Silage' (H.M. Stationery Office, 1s.) gives normal rations. Pure Comfrey silage is at the top of the high-protein class, and comes in the very-high-protein or 'A' category. Mixed with a high carbohydrate mixture, it will improve the grading, from D to C or B, depending on silage-making skill and the original composition of the balance.

No work has been done on the nutritional side for dairy or beef cattle, and we depend on information from before this type of research was possible. It is likely that both wilted in summer and as silage in winter it will be of value to the bullock fattener. Its use for 'unthrifty' beasts is traditional, but like a 'bursting' this is an all-embracing term, and success depends on why the beast was in this condition; also,

it may be helpful merely because sick cattle seem to find it an attractive food.

By all accounts it is an excellent calf feed, chopped at first and then as whole wilted leaves or hay. The softness and low proportion of fibre make it good introduction to normal diet. At Little Weighton it was used in the 1940's for rearing calves on calf gruel with a very small milk allowance. It was from this work that its value as a scour preventative for calves was established.

House Cows

Where only from one to three cows are kept for domestic supply, the advantages of Comfrey are greatly increased. The beasts are usually of the smaller breeds, and their pasture area is often restricted to a small paddock, perhaps hard to improve by ploughing and reseedling because of size or difficulty of access for farm machinery.

Though those who write for the owners of this type of herd stress the value of feeding surplus vegetables, sufficient of this forage for the appetites of several cows is costly in week-end time or gardener's wages. It is not a question of kitchen garden size but the labour involved in growing fodder by hand that is the limitation. Here a small-scale Comfrey plot (see Chapter VI) is extremely useful. Feeding should be in the proportions suggested for other green food, after wilting until the stems are so flabby that they hang down like soft, green ropes. The appetite of the beasts is the best guide, and this may be higher than for normal fodder where the pasture is poor and has mineral deficiencies. There is a chance of real gain both from this and the strong possibility that some of the digestive troubles of the Channel Island breeds under unskilled management or on a poor diet may be ruled out completely.

It is easy to make good hay from Comfrey on this scale. The crop is cut, wilted for twenty-four hours, tied in bundles and hung in a dry shed until the leaves are crisp and the stems break like sticks. The wilting is to prevent the strings coming loose as the crop shrinks in drying and when this is complete the fodder is stacked and the next cut is ready to hang. It should be cut each time when the first flowers are just opening, and analysis will show that both the protein and carotene are far richer than normal meadow hay.

The first method is independent of weather, wet bundles will drain like clothes on a line. Another method, which needs hot but not necessarily rainless weather, and is very much less time-consuming, is as follows: Cut and spread thinly on top of a black-painted corrugated iron roof and leave it there

until it is dry, before replacing with a further cutting. A black surface absorbs sun-heat, metal conducts this until the inside is uncomfortably hot and if the roof is over a pigsty or poultry-run, this is of considerable additional benefit to those inside. The Comfrey layer provides first a green surface and then a yellow and brown one, with air spaces, and the heat that does get through is used up in evaporation to some degree. The quality is better than for normal hay and in a wet summer there is an advantage from more sun-heat in proportion, and the fact that the rain runs quickly off the roof.

The second method is a development of the smallholder's trick of forking weeds on to the roof to keep the pig cool, but both are in use by modern goat-keepers. The product retains its scour curing qualities, and as this passes unchanged through stock if no internal irritation is present, its concentration does not add a problem. A further method has been tried in Kent, drying in an oast-house unused except when hopping, by the air current through the cowl produced hay with 20 per cent protein and 13.5 per cent fibre but though this is richer than any meadow or lucerne hay, the shed-roof system produces better results with less handling.

Comfrey for Horses

With the passing of the working farm horse from most holdings, the main value of Comfrey is for racing stables and studs and riding schools. The relatively low carbohydrate is no disadvantage, as horses are not fed for fat and the mare's milk is sufficient without need to force high yields with concentrates. The clergy of the past used it for cobs, ponies and hunters with success that is reflected in many letters to contemporary periodicals.

The improvement in condition secured by the gipsies was no-trick, though it may well have blinded the eye of the buyer to other defects. It was merely a method of supplying, in quickly available form, the dietary deficiencies of the fodder from common and roadside. The most rapid effect was from feeding several handfuls a day of the washed roots and very probably their higher proportion of allantoin, removed all 'winter torpor' after the season when wayside grazing would have been poorest and brought the beasts into splendid 'bloom' in only a week.

The tradition is common to gipsies all over Europe including Britain, and extends to North Africa and parts of Asia. It is likely that the broken fragments from roadside feeds of such indestructible plants account largely for the wide distribution of the mixed species. No form or species has

any long-range seed dispersal mechanism, the few seeds germinate in the colony, but the caravans have been travelling the roads of Europe for a long period of horse-dealing time. It should be remembered that between 1800 and 1900 there were not only more gipsies but they sold more horses, and enjoyed a higher reputation among the peasants as animal doctors, than is the case to-day. There is no tradition that any type was better than the rest, though *Symphytum tuberosum* was avoided, nor is there any belief that cultivated Comfrey as roots or foliage, stolen from a non-gipsy, brings bad luck in a horse deal.

At Little Weighton *Symphytum peregrinum* is fed *ad lib.* to working stallions but when it has to be cut down because of the needs of mares, the regular allowance for adult stock is approximately fourteen pounds per head per day. It is part of the regular diet from early April to the end of November, being replaced in winter with bought carrots; the plot is not sufficiently large to allow a surplus for hay-making. The object here is not to save money but to keep valuable animals in first-class condition. Some savings have been made, but over a long period of rising costs these are impossible to calculate; but as feeding-stuffs have been severely rationed there has been some gain in spreading the allowance over rather more mares. The greatest gain is in avoiding digestive disturbances, urinary complaints and above all, foal scouring, and this benefit is incalculable. Though Comfrey is no 'cure-all' and its limitations can only be determined by veterinary research, its use as a feed reduces the number of things that can go wrong with highly-gearred and sensitive race-horses. This is the opinion, after ten years of use, of a man who has spent his life with horses; it is not based on analysis figures or veterinary textbooks, because so few of these give any attention to Comfrey, which is not connected with allantoin by modern writers.

Mr. Stephenson has had much experience in accustoming mares to Comfrey and, after allowing for those which are sent to him season after season for service, he considers that 90 per cent of horses take to wilted Comfrey at once, and the remainder will take to it with a little coaxing, and feeding at first in small quantities. Phideas in Plate 12 is eating some almost unwilted that was cut by the writer a few minutes earlier.

One racing trainer is using Comfrey, which he wilts, chaffs, and mixes by hand into a previously boiled mash and feeds twice daily; his quantities and the other ingredients of the mash are not available. It is in no sense a 'speed food' or a dope, it merely improves condition and rules out some of the

troubles that cause a good horse to be 'scratched'. The allowance for polo ponies in India of green fodder was approximately 4 lb. a day, and between this figure and 6 lb. is about the minimum of wilted Comfrey that would have any effect. Above this low ration, feeding is a matter of experience.

Perhaps greater advantages are in feeding show jumpers, hunters, children's ponies and all horses at riding schools or where they are kept in small numbers under much the same conditions as house cows. A restricted grazing area, and feed limited by cost or rationing, often means a diet far nearer gipsy standard than the owner would choose to have for his horses. Where hay has to be bought in summer to supplement grazing it should be possible to replace up to 75 per cent of this with wilted Comfrey in a riding school, with an advantage over very good grass in the reduction of the fattening effect; the carbohydrate is there for energy, the proportion is simply nearer the needs of a horse than in a richer grass than he would get in nature. Horses do not graze clovers to any extent though lucerne is eaten readily, and it is far easier to grow a smaller area of Comfrey and to feed over the longer season, than to provide vegetable protein in any other way when the grazing is inadequate. This is apart from any gain in condition or health.

The experiment of the Rev. E. Highton in 1875, was repeated in 1953 by Mr. Stephenson with Tom Atom, a four year old gelding and a stallion. Comfrey *ad lib.* turned out to be roughly 40 lb. per beast a day fresh weight, and the oats were reduced from 8 lb. a day to 4 lb. With this as the sole diet both beasts thrived. The stallion was not working, but Tom Atom was used as a trainers hack through the summer, and did two days a week following hounds with the Holderness until the experiment was discontinued when the crop went dormant, leaving both beasts in fine condition. The saving on hay and other food worked out at 17s. 6d. a week per beast, including cutting cost, and though lesser savings would be secured were Comfrey replaced a less thoroughbred diet, the gain in condition without loss of performance is added to economy.

Comfrey hay, made by the methods described in the previous section, and fed at first in small quantities with other fodder, would be a help with winter keep. The finer points of its quality are measurable not by chemical analysis but by race-horse trainers; if it shares the qualities of very old but good meadow hay, it is possible that either of these non-commercial methods would pay, in view of the difficulty of buying really good stuff at a reasonable price. It may do,

and the knowledge will stay under the caps of the discoverers.

Sheep

Sheep were stall-fed on *Symphytum asperrimum* in Ireland in the nineteenth century, but no details can be discovered of the rations, and this extraordinary system would be uneconomic to-day. It was also the sole diet of working donkeys on the Carnew Castle farm. The general practice for the crop with sheep at this period was to feed it in early spring by scattering on the pasture to improve the milk yield of the ewes, and again as a help in autumn fattening on poorer land. It was used for folding arable sheep in a few cases, but no real information is on record.

As with cattle, the value is at both ends of the season, with hay or silage to take the summer excess if grass is available and more profitably fed. No ration figures are available and no research has been done; the only course is to feed in increasing quantities and await results in the knowledge that the enthusiasm of the past, when sheep were far more common, must have had some foundation. There is abundant evidence that sheep never suffer from a 'surfeit' on it as they will from other lush forage crops. According to some writers they take rather longer to get used to the crop than cattle, but this seems to vary with which Comfrey was fed and how good the other grazing. When they have developed the taste they will graze it readily, but their close biting means damage to the crowns, which should not be grazed closer than three inches from the ground. They are on this account a good stock for a ley sown down on winter-ploughed Comfrey that is being destroyed. They kill less quickly but do not damage the pasture like pigs. Their lighter weight seems to bring rather less trouble from spreading the crowns and damage by treading, but this is debatable; it could be proved or disproved on established plots quite easily by trial of folding with an electric fence. Harvesting and scattering by buck-rake may well prove the most economic system.

Through the years there have been many attempts to use the Symphytums on hill sheep-farms where even at low productive levels the crop could be of value compared with the existing pasture. Extensive trials were carried out in Aberdeenshire for the late Mr. Thomas Jamison in the 1900's, with *S. tuberosum*, but these were unsuccessful. They are of historical interest as the first example of wasted research from the loss of the knowledge of the 1870's, and lack of botanical co-operation.

Experiments with the agricultural Comfreys have produced mixed results. The main problems are shallow soil from rock or hard pan and the difficulty of keeping the crop going in competition with acid-tolerant natural flora which take up the available nitrogen during its short growing season. Hill sheep also graze Comfrey very greedily, and in the early spring when the plant is growing at a climatic advantage over the late-starting hill grasses, the Blackfaces may bite it back so hard that it is crippled before it can become established. Though it is rabbit-resistant and there are no records yet of deer grazing on Comfrey, wilted foliage cut and left to accustom sheep to the fodder may teach the deer the value of the new feed as well.

The most favourable prospect is probably the use of the plant as a fodder crop on the 'intake' near the farm buildings where it could be run under poultry as on a lowland farm. It could then be cut and scattered on areas where dunging and close grazing would extend good patches, especially after a hard winter. Though feeding in this way would mean time, driving skill and tractor expenses, it would carry plant foods via the dung as well as fodder. The altered ecological balance of these patches, selected in rotation to avoid parasite risk, would increase stocking capacity as a byproduct.

The crop has the advantages of avoiding the difficulty of snatching a seed tilth in a late spring, evading the early drought risk of the Highlands that endangers kale, as well as earliness and resistance to short sharp frosts in the growing season. Yield figures are misleading but it is likely that the gap between Comfrey and orthodox fodder crops on some hill land would be wider than in the lowlands, especially in a bad year. Table 3 should be considered in relation to yields on one's own farm. The value as winter keep would only be as silage or a silage reinforcement in view of the difficulty of even making normal hay under hill farm conditions.

There is justification for further experiment on the hill lands in the most likely positions on the deeper soils in the valley bottoms among the bracken. A cut about May, followed by planting the crowns either after ploughing and preparation as for orthodox reclamation or direct with a dibber among the stems and withering foliage, is a suggested method. Successive bracken-cuttings at six-week intervals should keep the crop ahead even though the sheep are not grazing the area. In the second spring the early grazing should be of great value. The essential need after this grazing is to cut at least twice in the summer when the plants will be throwing up weak flower stems, not only to keep back the bracken but to stimulate the crop for autumn feed and to give

it strength to compete with native grasses. These cuts can be spaced to fit the July and August bracken-cutting time and are of value even if the crop is left to waste. A tractor should be on the hills at this time anyway where bracken is the enemy, and once it is killed by this method, the potash balance problem is solved. It is likely that in balancing this weed, that is killed by cutting and monopolizes the good land, against the crop that thrives on mowing and has the same growth speed and soil tastes, will prove the best line of development.

Goats and Comfrey

Goat-keepers have always been the most successful small-scale Comfrey growers. Though the modern milking goat is as productive in proportion to body weight as a Jersey cow, this yield cannot be secured on roughage. No one has ever determined the starch equivalent of the digestible fibre in brambles in terms of the goat's digestion, but it is certain that the sort of rough grazing that goats often get, falls in protein and carotene as it runs to flower and fibre and is lower in early spring despite selective tip grazing for maximum nutrition. The goat-keeper has rarely the good grass of the normal farm available, and in Comfrey wilted to roughly lucerne value he has found a very useful cheap balancer protein source.

Goats will graze Comfrey; they may need a few trial feeds of the wilted material but in general they take to it unwilted. They have been folded on the crop, but where it is their sole feed, falls in milk yield have been noticed. Its role should be that of a low-labour-cost 'concentrate' to balance the maintenance ration from poor grass and roughage.

It has been fed at milking time or in the evening with any other available green food, and as with horses, some coaxing may be necessary at first with some beasts. It is also scattered direct on the grazing as with cattle, but tethering on a Comfrey patch risks the crop and not the animals, though folding with a wider area means less close grazing. One well-known raiser considers that Comfrey has a great advantage over marrow-stem kale, which he grows well but is discarding as a goat feed. Comfrey can be fed in all weathers as its leaves tip off the rain very rapidly and seem completely self-drying despite the bristles. Wet kale is not eaten by goats and in rainy periods there is constant trouble in drying off the surface moisture, for the water collects in pools on the stiff leaves.

Rationing is a matter of experience and can be judged by normal green-fodder allowances from standard textbooks

when the taste has been established. This can then be stepped up to an *ad lib.* feeding with a watch on the milk yield of extra-greedy nannies. The midsummer cuts can go for hay on the small-scale methods described. These add quality to the normal hay made on this scale and with roots alone can make up a complete winter diet if sufficient is available. The early cuts are of special value because rough pasture is later starting than improved grasses.

Comfrey is of perhaps the most immediate advantage on the holding with a few goats, a pig and some chickens and no paid labour. Once planted its cultivation needs few implements and takes little time, and the small area is no worry to the man whose 'farm' is under five acres.

CHAPTER V

Russian Comfrey for Pigs and Poultry

In the Middle Ages it was said that famine first placed its foot in the horse's manger, for oats and beans could be ground and added to the bread when a bad harvest meant wheat shortage. To-day the feet of the Ministry of Food or its equivalent in other countries tread first and heaviest in the pig trough and the poultry food bin, as 'steps are taken' to deal with an economic crisis in the supply of basic food stuffs. The pig is a very efficient converter of food into meat, roughly five pounds for every pound of live weight gain, the fowl very much less so, but both are directly competitive with human beings for nutritional needs. Therefore, though the problem is now considered in terms of 'coarse grains' and ration coupons, both for stock and human being, the principle is the same. Feeding-barley becomes 'potentially millable' and oats cease to be 'Sussex-ground' and become porridge and bread, even though the harvest that has failed is now one from exported industrial goods.

The problem is that of digestion and economics, for to produce the sort of pork and bacon in the sizes required (it is a necessity that bacon should fit the slicing machines in British grocers' shops, which are made to handle Danish bacon reared on dairy by-products) on the swift factory routine that pays the pig farmer, large quantities of concentrated feeding stuffs are required. The bulky diet and plentiful exercise that grew the medieval pig, whose feeding needs served as a measure of beech woods in the Domesday Book, meant a product which would only be tolerated to-day as an expensive 'off the ration' import in times of scarcity.

There have been many attempts to spin out the concentrated foods, rationed by coupon or the price in relation to the return per score or per dozen eggs, by means of swill and crops produced on the farm, which are still expensive in labour, seed, fertilizers, and investment in land and machinery. Swill, too, with its need for frequent collection, bulk in handling and boiling, has been used extensively. It has a drawback in the fact that the greater the need for pork and bacon, the less the nutritional value, and many pig-keepers remember the difference in flesh-building power between army camp and civilian swill.

It is in this field that Russian Comfrey can make its most important contribution to farm economy and to Britain's food



10. Neglected Comfrey on poor land. Allowing the crop to run to flower and stem can ruin the yield for the rest of the season.

supply. Every writer since 1810 has stressed the real pleasure pigs have in eating Comfrey: there is never any question of wilting or getting them used to it by degrees, and one has only to offer a troughful to receive a very quick answer to the statement that 'no stock will eat it'. Pigs will eat a great many things greedily, even cinders if their mineral nutrition is neglected. The question is, can they be fed on Comfrey at a profit, and if so, how much can be used to replace scarce or expensive feeds?



11. A daily ration for mares and foals improves condition, banishes scour and saves more expensive feed.



12. Phideas, sire of Frieze (1952 Oaks winner) and many others, enjoys some extra Comfrey. Stallions and mares at Little Weighton leave none for hay or silage.

Pig Fattening on Lucerne

Though experiments with feeding Comfrey have not been undertaken by any research station there are reports of successes, with nothing measured or weighed, on this fodder plus swill, which is, of course, so variable that no reliable information can be obtained from any reports.

The following experiment with green Lucerne was reported in the *Dairy Farmer* for October 1952, and because both fodder crops are so alike in composition the account is repeated here. (See Tables 1 and 2 on page 53.)

'We had two pens of pigs, Essex sows by Large White boars, each containing 4 hog pigs and 4 gilts. Our aim was to start with all pigs weighing about 100 lb., but they actually varied between 75 lb. and 100 lb., which made the experiment more interesting, as we found that the lightest pigs gained as much as the heaviest, thus showing that one can start feeding green lucerne *ad lib.* at an early age.

'The control pen was fed according to normal farm practice. The pigs had 5 lb. of meal a day during the first week of the experiment, gradually increasing week by week to just over 6 lb. a day. They also had one meal a day of about 10 lb. of cut lucerne per pig. The experimental pen was restricted to 3 lb. of meal per pig per day and was fed twice daily with green lucerne, as much as they would clear up.

'Weighing was weekly except towards the end of the experiment, when pressure of farm work caused us to adopt 14-day intervals. For the first three weeks the lucerne-fed pen recorded a greater gain in live weight per pig; thereafter the control pen pulled steadily ahead, as shown in the table below:

| AVERAGE WEEKLY PROGRESS PER PIG. (N.B. The eighth week was exceptionally hot.) | | |
|---|-----------------------------------|-----------------------------------|
| <i>Weeks of Fattening</i> | <i>Control Pen lb. gained</i> | <i>Lucerne Pen lb. gained</i> |
| 1st | 16 | 15 |
| 2nd | 11½ | 14 |
| 3rd | 2½ | 3¾ |
| 4th | 11½ | 4½ |
| 5th | 13½ | 7¼ |
| 6th | 21½ | 14½ |
| 8th | 1½ | 6 |
| 10th | — | 19 |
| 11th | — | 7¼ |

'It is difficult to assess the cost of the meal. Some was homegrown, some purchased—the latter mainly in compound form. So I have allowed it at £28 a ton, which gives a round figure of 3d. a pound.

'The control pen consumed 3,120 lb. for a live weight gain of 860 lb.—a cost of 10½d. a pound. The lucerne-fed pigs ate 2,310 lb. of meal—a cost of 8½d. per lb. of gain. From the 11th week of the trial, when the lucerne-fed pigs were weighing between 147 and 180 lb. and some were only gaining about 5

lb. a week, we increased their meal allowance from 3 lb. to 5 lb. a day. A much greater rate of progress was soon observed.

'The conclusion I have drawn from this experiment is that one can start feeding lucerne *ad lib.* and save some meal when a pig weighs only 70 lb., and that it will thrive well on 3 lb. of meal daily until it weighs about 130 lb. From then on I would give more meal—4 lb. a day until the 160 lb. mark, then increasing to 5 lb. of meal a day.'

In correspondence with the author, the Suffolk farm manager who carried out the experiment adds the following information: 'It is rather difficult to state how much was fed to the eight pigs, as we were feeding lucerne to other animals as well and had some 20 acres to cut from. I would estimate that 8 pigs would require about 50 lb. of lucerne daily at 70 lb. live weight, 112 lb. at about 150 lb. live weight, and perhaps 200 lb. just prior to killing. Less than a quarter of an acre of a good plant of lucerne would supply this amount if cut on rotation'.

Pig Fattening on Russian Comfrey

The late Kenneth Crawley fattened pigs on Comfrey, and though none of his carefully recorded results survive, he states that one can feed it *ad lib.* and save half the normal meal. This is exactly what one would expect from the Lucerne experiment, and the many references to the value of the crop for pigs in the past. With Comfrey one is feeding approximately the same bulk of food, with some important differences.

Wilted to 75 per cent moisture, which is very easily achieved, the two feeds compare as shown in Table 2. The dry matter is 24 per cent for lucerne, 25 per cent for Comfrey, the crude protein 41 per cent against 6.85 per cent, carbohydrates 9.9 per cent and 9.8 per cent, but the fibre is 7.2 per cent against 3 per cent and the ash 2.4 per cent against 4.6 per cent. It will be seen that with a tenth of 1 per cent less carbohydrate, and 2.75 per cent more protein, any balance is in favour of the Comfrey. Wilted in the same way, green lucerne would be very much richer, but the excess fibre would show through like the ribs of a wrecked ship at low tide, and the Comfrey is still very much less than half as much, with more mineral-rich ash and about a third more oil. Pigs digest some fibre, but cellulose digestion is always incomplete, and in practice the 'digestible fibre' column can be ignored.

The repetition of this experiment, using Comfrey, is within the scope of any pig farmer who weighs as a matter of

routine, and its incentive lies in the following advantages, which can only be proved or disproved in practice.

(1) The longer period in cut gives a chance to put through two batches of store pigs in a year. Starting off with a really early cut of young Comfrey when the need was only roughly

WEEK BY WEEK WEIGHT COMPARISON ON GREEN FODDER
(Lucerne-fed Pigs)

| <i>Starting Weight</i> | <i>1st</i> | <i>2nd</i> | <i>3rd</i> | <i>4th</i> | <i>Weeks</i> | | | | | | | <i>Dead Weight</i> |
|------------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|------------------------|------------------------|------------------------|------------------------|--------------------|
| | | | | | <i>5th</i> | <i>6th</i> | <i>8th</i> | <i>10th</i> | <i>11th</i> | <i>12th</i> | <i>14th</i> | |
| <i>Control Pen</i> | | | | | | | | | | | | |
| 90 | 115 | 125 | 127½ | 140 | 152½ | 180 | 177½ | 197½ | — | — | — | 147 |
| 82½ | 95 | 105 | 107½ | 122½ | 130 | 147½ | 147½ | 167½ | 175 | 187½ | — | 146 |
| 75 | 87½ | 97½ | 100 | 110 | 120 | 140 | 142½ | 162½ | 172½ | 182½ | — | 140 |
| 100 | 110 | 120 | 122½ | 135 | 157½ | 180 | 182½ | 207½ | — | — | — | 157 |
| 95 | 102½ | 120 | 120 | 132½ | 147½ | 170 | 170 | 192½ | — | — | — | 147 |
| 87½ | 107½ | 122½ | 125 | 135 | 147½ | 170 | 175 | 195 | — | — | — | 147 |
| 77½ | 100 | 110 | 112½ | 125 | 142½ | 160 | 160 | 187½ | — | — | — | 144 |
| 85 | 102½ | 112½ | 117½ | 125 | 135 | 157½ | 160 | 182½ | 192½ | 202½ | — | 151 |
| <i>Lucerne-fed Pen</i> | | | | | | | | | | | | |
| 90 | 100 | 110 | 110 | 115 | 120 | 132½ | 125 | 142½ | 147½ | 167½ | 180 | 138 |
| 82½ | 92½ | 110 | 112½ | 117½ | 125 | 142½ | 137½ | 155 | 160 | 167½ | 177 | 133 |
| 75 | 87½ | 107½ | 112½ | 115 | 117½ | 135 | 130 | 145 | 157½ | 170 | 187* | 137 |
| 102½ | 117½ | 127½ | 132½ | 135 | 140 | 152½ | 145 | 160 | 167½ | 177½ | 200 | 150 |
| 82½ | 107½ | 122½ | 125 | 130 | 137½ | 155 | 152½ | 162½ | 170 | 180 | 190 | 143 |
| 85 | 102½ | 115 | 117½ | 122½ | 137½ | 152½ | 147½ | 170 | 180 | — | — | 143 |
| 77½ | 97½ | 110 | 112½ | 117½ | 127½ | 142½ | 135 | 155 | 157½ | 177½ | 192* | 142 |
| 82½ | 102½ | 117½ | 127½ | 132½ | 137½ | 147½ | 172½ | 180 | — | — | — | 136 |

60 lb. per pen (more to allow for the wilting; only water is lost), rising to about 225 lb. in time for the June growth peak. The second batch would start off with a low Comfrey need, but a cut for hay or silage then would put something in the barn towards winter keep for breeding sows. The final batch would finish on the last cuts. It is unknown how early in the life of a pig Comfrey can be fed with live-weight gain; it has been fed green to piglets still suckling as a scour preventative and cure, with complete success, though with no recorded progress or comparisons of live weight gains.

(2) The greater weight of nutritional value per acre, over twice as much carbohydrate on a 75-ton yield as from an 18-ton-an-acre lucerne crop, means rather more than twice the number of pigs are fed off the same area, from a fodder that is suitable for a wider range of soils.

(3) Because pigs are genuinely fond of Comfrey and because so much less fibre is being fed, it is likely that '*ad lib.*' would mean a greater daily total consumed and a greater live weight gain in proportion to the meal supplied.

(4) The additional vegetable protein might enable cheaper meals with higher carbohydrates, or processed swill, to be used with profit. It should be recognized that the pig is an omnivorous animal and non-vegetable protein is also required, as fish or meat meal or in a compound form.

(5) The Vitamin A and minerals, especially the calcium and iron in the ash, would be supplied more easily than in an artificial mixture, apart from the value of the allantoin.

The balance between Dr. Voelcker's 'flesh-forming substances' and 'heat-and-fat-producing matters' (carbohydrates) should be watched, as the last is very slightly down on lucerne, and even on this crop the need for meal at the end of the fattening period sprang from this shortage. It is also the roughly equal proportions of fat and lean which bring the best price for baconers.

If this experiment were tried with a first-year acre of Comfrey, it would be best to run a single batch starting about May, reaching the peak demand of 225 lb. for 8 pigs about the end of July or early August, when the crop is growing most strongly. The number of pigs per acre depends, of course, on the yield, but with the peak cuts running between 20 and 30 tons an acre on an established crop, and two batches of pigs going through, crossing the crop in a fortnight instead of the normal month increases the supply as a temporary measure. The fall in demand as the next batch of fatteners comes in enables the growth to catch up again. The general average should work out at about 80 pigs off an acre. The Germans allow 25 square metres per pig, roughly 30 square yards (see Hegi's *Flora von Mitteleuropa*), but no statistics are given of the size of the ration fed, or how much meal, or whether these were for pork or bacon. As a trial on a first-year planting on reasonably rich land, a quarter of an acre should run four pigs on this system in a single batch.

The finer points of management, balancing the cuts against the increasing demand on each batch, the stage at which to start Comfrey feeding, which may be as low as 50 lb., and the exact proportions of meal, which may well be less than for lucerne, remain to be worked out. We know that for over seventy years this crop has been fed successfully to pigs by far more smallholders and farmers than ever wrote to *The Field* about it, but not one has recorded the sort of facts and practical information that any agricultural college could secure in two years' work.

The economics of pig-keeping vary with non-agricultural factors, but it is unlikely that the prices of concentrated feeding-stuffs will fall, and their supply depends on political circumstances, in their widest sense. The less expensive

material per score that is in the British pig the better for both farmer and public, in terms of profit, and in terms of more pork and bacon for the same land area or amount of exports spent in payment for food from overseas.

The modern Danish-type piggery, which is often understocked in periods of meal rationing, would be ideal for this type of feeding, and the heavy production from a small area on even poor soils could be maintained by generous use of pig manure. As the stock would not be in contact with the land, there would be no risk of worm infestation, and those who have doubts concerning the 'perpetual motion' of feeding the crop with the dung should remember that the manurial value of the other portions of the diet is going back into the land. The disadvantages of the outdoor system of running pigs on pasture, with coarse and ungrazable grass as the only return from the manure, would be avoided.

This application of the crop is the most promising of all, and the urgent need is to master the technique of fitting the feeding system to the crop. The exact stage of wilting may be of very great importance; the reduced bulk of even a 65 per cent moisture total as fed, still with only 4.25 per cent fibre to 13.8 per cent carbohydrate and 9.5 per cent protein, might be a very considerable advantage. No silage or hay-making difficulties need arise, the crop is simply used as it grows, and the final stages of a late batch finishing after November could be on ensiled potatoes and meal or other traditional diet.

The best small scale application is for breeders, who feed after farrowing as a supplement to normal rations, increasing the quantity as the piglets take to it. This takes the strain of a large litter off her milk and pulls the runts ahead with the liveweight gain of high vegetable protein and low fibre. It removes the scour risk from both sow and litter, including *bacillus coli*, as well as digestive troubles.

Russian Comfrey and the Poultry Farmer

The modern system of feeding for eggs and table fowls is based on the supply of extremely concentrated foods. Poultry farming is to-day operating on a very much smaller margin between the price of eggs and the cost of feeding-stuffs, because almost all these must be bought, and in good quality. The digestion of the fowl is even less fibre-tolerant than that of the pig. It is simple and contains no bacteria able to digest cellulose, and the stomach secretes no enzyme which can deal with it. Therefore, though a pig can get some nourishment out of the 'digestible fibre' portion of his diet—a negligible quantity compared to the horse or to cattle whose digestions

are adapted to fit the high-fibre grasses—with the fowl, fibre is an active disadvantage.

When the crude fibre of any ration reached 10 per cent, 10 lb. in every 100, there may be a reduction in the digestibility of the carbohydrates ; at higher rates this is certain to produce a heavy fall in egg yields and delayed maturity, however rich the rest of the diet. The crude fibre should vary between 5 per cent and 8 per cent of the total diet, and the nearer the lower limit the better, though this small proportion is of value in keeping the food mixture in a more open condition on its relatively short journey, and allowing the digestive juices to have the maximum effect. As Sussex-ground oats, as an example, are right up at the limit, 10.3 per cent, less fibrous foods must balance the diet at a lower level. Though in nature a flock of jungle fowl would eat considerable quantities of green food, and obtain plenty of 'animal' protein from insects and even small lizards, they are not endeavouring to return a profit measured to within three places of decimals in fractions of a penny per bird. Green fodder is to-day valued purely as a means of providing some exercise, some interest in meal-times (which prevents cannibalism and 'vice') and Vitamin A. Its eclipse, except in the backyard where a swinging brussels sprout stem or a handful of chickweed is the feathered world's equivalent to the arrival of mail or Red Cross parcels, is due to the knowledge that it overloads the digestive system with bulk and fibre, to the exclusion of more nutritious foods.

The digestion of the birds has other peculiarities. 'Crude protein' as it appears in Tables 2 and 3 includes a number of amino-acids (which are the varied substances into which further research has divided the 'mucilaginous and flesh-forming matter' of Dr. Voelcker's days) which are of little use to poultry, and others which are useless without balancing supplies of other forms. The 'digestible crude protein' column is less misleading, and in Table 3, the final column gives a better comparison than 'starch equivalent', which includes useless fibre. Another misleading figure is that for 'nitrogen-free extractives', because this includes the pentosans and hemi-celluloses, which a cow takes in her gastric stride, whereas only the starches and sugars are of value to the bird. The comparisons should therefore be from columns 7 to 11 of Table 2, and Table 3, with the total in column 14. The 'V factor applies to grazing mouths only, not beaks of any type.

The protein requirements of poultry vary with age; the need is highest for young chicks, at 20 per cent up to 8 weeks, and 16 per cent for the next 10; laying or breeding birds need roughly 15 per cent. This is the proportion in the total diet,

and where attempts are being made to supply this protein in the cheaper vegetable form, even as bean or other meal, 2\ to 5 per cent of these totals {not of the protein in the diet) should be fish or meat meal.

Vitamin A and Dried Green Foods

Vitamin A is a fat-soluble vitamin present in large quantities in certain fish oils, cod, halibut, shark, and in immense amounts in certain tropical species. Supplied in concentrated form to the poultry mash it is extremely expensive, but a deficiency produces disastrous results. The normal supply is from green food, in which it is present as carotene, which is built up by the bird into the vitamin. Yellow maize contains a small quantity, other cereals none, and though whole milk has a considerable amount—hence the success of goat-keepers who mix unwanted milk in the mash—separated milk, liquid or dried, has not the fat-soluble vitamin which is in the removed butter fat. As green fodder contains not only this essential substance, but the whole Vitamin B complex apart from B. 12, which is the animal protein vitamin, there have been attempts to incorporate dried crops to give these substances, with some vegetable protein, in concentrated form as dried grass and lucerne (alfalfa in the United States) meal.

There are two difficulties, and the first is the fibre. Really good dried grass contains almost as much fibre as protein, and a poor grade anywhere near the national *average* of 13 per cent can contain twice as much, which uses up the safe fraction at an alarming rate. Lucerne meal, though 14 to 15 per cent protein is common and 22 per cent really good (as with grass, this varies with the cutting stage), is between 31 and 18 per cent fibre. Therefore only very small fractions can be mixed in with the mash. Between 7½ and 10 per cent are the maximum quantities recommended by the Harper Adams Agricultural College.

It is possible that Russian Comfrey, cut at the leafy stage, would provide a special poultry meal, with 22.7 per cent protein to 10.9 per cent fibre and 38.2 per cent carbohydrates (Hannah Dairy Institute figures). This would not only give as much protein and rather more carbohydrate for well under half the fibre of the best lucerne meal, but the carotene content would be comparable. American samples of alfalfa meal from 305 commercial driers averaged 158 mg. per kg., ranging from 8 to 390. Only 4 per cent of these producers were turning out a product over 200 mg. per kg. Russian Comfrey, with 400 mg. per kg., admittedly from one sample only, is at least on the same footing.

Whether the product would be of this value awaits the experiments of anyone with a commercial grass drier, and any poultry husbandry research station willing to try out several hundredweight of the meal, which has never been available; its palatability has been judged purely on colour. The dustiness reported would be due to the remains of the finely divided silica of the bristles and that on the way up the stem to leaves as yet ungrown at the time of cutting. As poultry in any event take no harm from the silica ground from the grit in their crops this is not likely to be a problem. The 14.1 per cent of calcium of the ash content might be of considerable use as an incidental advantage. It would be most unwise, however, to use it before test results are available, because it is likely that a higher proportion in the mash might be uneconomic, though possible because of the low fibre. Dried Comfrey, even wilted down to 65 per cent moisture and put through a shredder, takes a very large quantity of fuel to evaporate the moisture, very much the same as dried grass. Therefore the product may be better, but if it is going to be as costly, feeding beyond the Vitamin A need depends on competitive prices and whether an alteration in the diet pays in results. It might be excellent; no one has tried.

Vitamin A and Green Fodder.

The second and most important problem in supplying the green food vitamins in a concentrated dried form, is very much more complex. The pamphlet published by the National Institute of Poultry Husbandry 'Vitamin-A Metabolism in Poultry', by H. Temperton and F. J. Dudley (Harper Adams College, 6d.), discusses the question in detail with a wealth of experimental results. Though, as an example, a poultry farmer may buy a grass or lucerne meal with an analysis showing 300 mg. per kg. of carotene at the top price as it is sold on the quantity of carotene in the sample, and may, therefore, expect to feed only 1.4 per cent to supply the 3,300 International units needed per lb. of food by an adult layer, he does not necessarily get this. The sample was taken from the batch by a commercial analyst and records what was there at the time of measurement, but the carotene varies most erratically with storage, either in the driers' warehouse or in the bin on the farm. The 300 mg. per kg. could drop to 150, and recover to 200 in four or five months. The problem of stabilizing carotene is the subject of much research, but until it is achieved, the poultry farmer should judge by results and consult his local poultry advisory officer before paying for the more expensive grades of meal as a vitamin supply. It is

unknown how far Comfrey meal shares this skeleton in the cupboard with lucerne and dried grass, but less fibre does allow some latitude for increases to make up for loss in storage.

This returns us to a reconsideration of green fodder and the feathered party happily scratching among the chickweed; how far can we cut out the fuel cost of grass drying and replace the variable carotene which has to be paid for at its peak with that which also varies as grass and other crops march from the growing stage to flower and seed, but is chargeable at a constant rate in labour and land? With folding, free range or any other system of poultry on grass, the problem does not arise, but the economies of concentrated feeding in batteries and on deep litter justify an attempt to see if it is possible to use natural vitamin supplies at a profit.

Russian Comfrey as Green Fodder

An experiment at the Harper Adams College with increased green food produced the following results: Two and a half ounces per bird per day were fed to eight-weeks-old pullets and layers to provide 10 per cent of the dry matter of the mash. The green food was grass mowings, 80 per cent moisture, and the result was delayed maturity for the young birds and for the hens a 50 per cent drop in egg yields.

The same feeding system was tried by Mr. E. V. Stephenson with his laying battery, feeding 2½ to 3 ounces a head of wilted Comfrey per day, with no fall in egg yield, and a saving in concentrates amounting to an ounce a day per bird. He states that his birds were in perfect health and if the daily Comfrey ration was missed, they became unsettled and unhappy. The great advantage was the ease of cutting and supplying the same green fodder from April to November, with none of the difficulties of sowing and raising successive green fodder crops. The gap in winter was filled with stored carrots and swedes.

This is, of course, a single experiment, carried out in four successive seasons with the same result, and whatever the inaccuracies of weighing, it does show that one experienced poultry keeper has fed considerably in excess of the normal green food allowance and made a considerable saving in meal. As the battery was used during the war for this experiment, the concentrates were not only expensive but rationed.

The Comfrey was wilted down to approximately 75 per cent moisture, before being put through a chaff-cutter and incorporated with the mash. At this stage its carotene would be nearly the same as that of fresh grass in spring (see the previous chapter), and ample Vitamin A would mean a good

colour in the egg yolks for the whole period. The fibre would be 3 per cent, which would be approximately the same as that of the lawn mowings, and there would be rather more digestible protein.

The normal green food ration, to provide Vitamin A and Vitamin B complex, is roughly one ounce a day, fed as wilted-brassica green matter (such as kales) but there is evidence from the past, of an enthusiastic but unfortunately non-statistical nature, that chickens will eat very much more than this when wilted Comfrey is supplied. This may be due to the taste, to the allantoin, or to the fact that its fibres are few and do not harden round the surface as the crop wilts. Because it is the cheapest of all sources of Vitamin A in terms of labour, it deserves extensive experiment by poultry stations, and by private poultry farmers, first on the ounce-a-day level, and then increasing to cash its food value in the maximum saving of purchased meal without a fall in egg production.

For deep litter poultry, Mr. Stephenson supplies a regular three ounces a day, very roughly, which is always cleared up, and he considers that he saves some meal, sufficient to make cutting and feeding on this scale pay well. The normal animal protein supply is included in the ration; without it, feather pecking and other trouble soon arise.

Though Comfrey seems of considerable value to growing poultry, before eight weeks old it should be fed chaffed. The fibres are few but stringy, and there is a risk of crop trouble with young chicks. This is avoided by making sure that it is in short lengths. Exactly the same trouble occurs with grass, but as the season goes on and grass and other fodder crops run to cellulose and stem, the risk increases; with well-cut Comfrey, which is a series of 'springs' so far as the foliage is concerned, the risk stays low.

Management for Poultry and Weeding Birds

The area under Comfrey needed for an ounce a day basis for the first year, increased to three ounces in the second and third, is very small. A daily cut of 1 cwt. 2 qrs. and 19 lb. is enough for 3,000 birds; 1,500 plants cut at the rate of 50 per day should supply this easily the first year, and three times as much the second. The cutting and carrying would be well within the routine labour capacity of the single man who should look after this number of birds on the efficient poultry farm. He would have a greater bulk to carry if larger quantities were fed, but little increase of labour, as he would still be gathering the crop off rather less than a third of an acre, sited as conveniently as possible for feeding, and

staying in that position, not moving away in accordance with the needs of crop rotation on the holding.

The weeding birds for this small area could be a semi-intensive flock, but on a laying battery establishment this might be more trouble than hand or motor hoeing up the middles as required. It might also be possible to clean up the crop at intervals by using it as a run for replacement birds coming in to lay, stocking more heavily up to backyard standards for short periods. Where a larger area was grown as for a piggery as well, with poultry green food as an incidental by-product, management would be exactly the same as a normal free range extensive system with mobile houses. The difference between Comfrey and grass as an exercise ground is that the aim is not to keep a sward under the birds, but weed-free soil. The amount of weeds and insects pecked up would vary with the season, but a proportion of wilted Comfrey would have to be fed, at least at the ounce-a-day level. The non-green food portion of the diet would be fed normally. The fertility from the droppings, roughly half the total produced, would be cashed far more rapidly than by grass, as pig or cattle fodder, apart from the value as an ingredient of the poultry ration.

There is no record of the use of Comfrey in rearing table birds, and it is possible that a low cost diet for surplus cockerels, including cheap green food in bulk, might be theoretically inefficient, but pay in practice.

Russian Comfrey for Turkeys

The turkey is far less of a seed-eater than the fowl and is therefore capable of taking more bulk in the diet. While the demand remained geared purely to the Christmas trade, the very efficient food to meat conversion ratio of the birds remained largely wasted in Britain, but with the introduction of smaller breeds such as the Beltsville Bronze, which fit the modern oven and family, an all-the-year-round demand is growing.

The main difficulty with turkey raising is the high mortality and disease risk in the early stages; digestive and other troubles mean that every bird represents so many headaches that the raiser prefers to feed for size. More and lighter birds represent more worries for the same cash return as a few raised to large sizes. These are now becoming unsaleable and there is an increasing interest in greater efficiency at the time of greatest trouble. As soon as the turkeys are gobbling and fierce the worries are over. The problem is to get them that far and make a profit, without

depending entirely on sales of the easy meat secured in feeding to Victorian family size.

After Kenneth Crawley's death large quantities of cut and wilted Comfrey were supplied to a neighbouring turkey raiser as a feed for chicks and growing birds. This material was chaffed and mixed with the mash supplied to turkey chicks from a fortnight old, in the proportion of half by volume. Dock leaves as a green food had been used before (a traditional 'any port in a storm' country poultry wife's idea), but now there was a very considerable fall in mortality and the chicks thrived on the new diet. From the evidence of the past, turkeys are very fond of wilted Comfrey, and these birds in the 1940's proved equally greedy for it. They picked out all the chaffed Comfrey from the mash to eat first and their improvement in condition was remarkable.

It is possible that the small percentage of allantoin in the leaf prevents or cures the minor gastric irritations which are among the enemies of young turkeys. It is also likely that the supply of really rich 'grazing' with a surplus of Vitamins A and B and low fibre with high protein produced the result. The Comfrey ration was continued until the birds were at the stage of powerful gobblers with their troubles behind them. The quantity fed varied with the age of the bird, and, so far as is known, no reduction was made in the amount or ingredients of the mash. The chicks simply ate more, enjoyed it, and thrived.

Though turkey chicks are expensive experimental material, there is considerable scope for the keen raiser to develop the green fodder system, and for further research. It is possible that feeding Comfrey, chaffed or whole and scattered on the exercise ground, would be extremely profitable, even though the live weight increases secured were smaller than for concentrates. With the green food produced cheaply, and lower mortality, there would be more profit on a smaller bird than a prize-winner, and the greater efficiency of the digestive system in dealing with fibre would be used to the best advantage. There is no detailed and figure-supported evidence; all that can be said is that the birds will not be poisoned. If it had produced spectacular ill-effects, the agricultural press would have frothed with it in the 1880's—and the evidence we have shows that it is a valuable feed that reduces the risk of ill-health in the early stages, the turkey raiser's chief problem.

There is a possible saving on the cost of concentrates, how much we do not know. The need of the turkey for animal protein goes up with maturity, and anyone who has lost his best birds in November because they have found the bodies of rats or moles poisoned with strychnine, or seen them gang up

like secret police on an unfortunate hen, will realize the need to keep the fish or meat meal in the ration. Savings are a matter of experience, the reduction of the normal five ounces of concentrates per bird per day may be possible, but an increase in hardiness and a fall in early mortality would be equally profitable.

Geese and Ducks on Russian Comfrey

In theory the goose is an ideal converter of Russian Comfrey into meat. For most of its life the bird is purely a grazer, and its digestion is designed to deal with grass. The composition of the grass will vary through the season; the nutritional value of Comfrey wilted to 75 per cent is higher in protein and carbohydrates than the best pasture grass with only four-tenths of 1 per cent more fibre. In comparison with the 'off the common' grazing in late summer, or the grazing growth nipped by geese between the ragwort on a run-back pasture, it is a rich concentrate.

We have no records of the economics of turning the goose into a restricted-range table bird fed on cheaply-produced green fodder in bulk; like the turkey, we have the evidence from the past that they like it, and the evidence of our eyes that they will eat it greedily. The only advice that can be given is to feed chaffed in small quantities in the early stages and increase the proportion to an *ad lib.* supply after about eight weeks old, feeding, as always, wilted. Grazing geese and ducks on Comfrey is possible but the economics of a folding system are not yet worked out, nor is it known whether the grazed crop recovers with the same speed as when cut.

It is possible that some concentrate savings could be made during the rearing stages, or on the three ounces a day supplied to breeding birds, but the goose is normally a low-labour-cost grazer, and is so hardy that there is no bonus to be earned from reduced mortality. The labour cost of supplying cut Comfrey, low though it is, must be balanced against grazed grass.

The main handicap of the goose as cheap meat is its greasiness. A bird at Christmas supplied enough goose grease to rub the small chests of a large family in the Edwardian days when this useful cough remedy was in fashion. As a grazing bird, without the cellulose-digesting internal bacteria of the ruminant, the goose picks high protein and high carotene leaf as long as these are available, but these vary with the season and the quality of the pasture. A Comfrey-fed goose is going to consume a constantly high protein diet and rather less oil (ether extractives) and carbohydrates, compared with a 'green'- or grass-fattened bird. The

preponderance of 'flesh-forming matter' over 'fat and heat-producing matter' could well produce a table bird more popular because it was less rich and greasy.



13. Micro-photograph of two Comfrey bristles cut from a fresh leaf and drained of the liquid that keeps them stiff and stock-repelling.



14. A wilting Comfrey leaf. Transpiration continues at full speed with no income of water from the root for some time after cutting. Note the edge bristles sucked flat into frail silica strips, no deterrent even to rabbits.



15. Scattered grain has brought the nearest birds out of the Comfrey, the tails of those still weeding can be seen among the foliage of the only green food that can be grown in the poultry run.

Just as the modern 'dairy-fed pork' must fit the standards of fat and lean set up by the Danish method of using surplus whey and butter-milk, and anything near the barley-meal-fattened pork and bacon of the 1830's would be impossibly fat for the modern buyer, 'Comfrey-fed' geese might well build a market for themselves.

The same limitations of lack of modern experience and records of experiment apply to ducks, which, though less fitted to the crop as non-grazing birds, offer more scope for cost reductions in the saving of concentrates. We know from the men who have said 'I feed Comfrey to chickens, ducks, geese and turkeys—I would not be without it', that it does not cause any ill effects, but in terms of average rations for varied growing periods, egg production, and live weight increased, we have a perfect and absolute blank.

One can only feed chaffed and try starting low and increasing the quantity. If some green food is fed, it may as well be Comfrey, and if the better quality of the feed enables a higher intake of this cheap product to replace more expensive concentrates, the gain is ours.

Conclusions

Unlike the possible advantages for the larger farm stock, the potential gain to food production from Russian Comfrey fed to pigs and poultry is clear. It is not bound up with the difficulties of conservation, as its growing period fits the meat-growing season of quickly matured stock, and so far as the consumer is concerned, the refrigerator and deep freeze can fill the winter gap.

CHAPTER VI

Russian Comfrey in the Garden

The Symphytums are old-fashioned flowers, as out of date as living through the winter on salted meats, or high hospital mortality from pre-antiseptic surgery. After their introduction, the whole riches of China and the temperate world were added to our gardens, and the gay annuals of the deserts and dry climates found a new and refreshing winter in our British summers. The not very free-flowering Comfrey species, with masses of foliage and almost unkillable roots, were completely outclassed by the new recruits to horticulture, which provide the maximum colour in the smallest space and therefore have kept in step with the needs of British gardeners. The tall and lovely blue *Anchusa*, in the same natural order, is far better flower value, even in a small garden.

The job of the Russian Comfrey is not to provide colour but a bulk of foliage for the compost heap; to use its questing roots, the swift and efficient leaves that can employ the smoke-screened sunlight of a city to fix the carbon dioxide even from petrol fumes faster than any other plant; to replace the vanished horse. As an ornamental foliage plant, in the *Funkia* or *Aspidistra* class, it has a by-product value in a town garden of being about the only species which will tolerate shade, a soil composed mainly of bomb damage rubble, ashes, soot and broken glass, and the robbing roots of trees, even privet hedges, and still fill the impossible corner with *something* green and growing.

As our cities spread, the capital value of the days when their soil was farm land or market garden, and well dunged for generations, is exhausted. London, with the last field of wheat at Hammersmith in the 1830's and the market gardens of Bloomsbury long under bricks, is perhaps the oldest example. To-day under concrete and steel, the fairy ring of vanished fertility spreads faster and wider round every city. Chemical fertilizers and bought-in humus, such as hop-manure and other organic compounds, have this in common ; all are expensive.

The organic gardener knows the answer, but far too often in theory only. He simply cannot make enough compost (as an example) to try out the 'no digging' system, using a two- to three-inch thick mulch on the surface, where Nature puts it. It may banish all pests and diseases and provide vegetables

of a flavour and health-giving quality unknown in these tinned and deep-frozen days. Or it may not; and he cannot try the experiment thoroughly for lack of humus.

Under every plot of ground, except where bed rock is near the surface, lie reserves of plant foods far greater than any that can possibly be supplied as chemicals. Composting provides the means of increasing the amount in circulation and the more deeply rooted the plants the more minerals are transferred to the current account, instead of being locked far out of reach like money in unfurnished-house property. The trees of a town draw their income from this reserve but invest it in timber and dead leaves, vegetable securities hard to 'cash', but easy to burn into forms quickly washed out of the soil.

Russian Comfrey provides the best answer we have yet to this problem; its roots have penetrated as far as eight feet, and its great bulk of readily rotted foliage is as rich in potash as bracken, of high phosphorus content, and high in quickly-available carbohydrates. These last, in a well-made compost heap, not only provide the fuel that can cook weed-seeds like grains of rice, and sterilize the product by the heat that runs up to 180° F. (eelworm destruction temperature, 112° F.; electric soil sterilizer, 180° F.) they also provide additional combined nitrogen. The free-living, nitrogen-fixing bacteria, of which *Azotobacter crocococeum* is the most effective, will add to a good compost heap between 20 and 25 per cent more nitrogen than is contained in the vegetable matter and the 'activator'. This last ingredient provides the starting capital of nitrogen in the form of organic manure, proprietary 'compost maker' such as Adco, Aboliser, Fertosan or other makes, necessary to begin the process.

Whatever the philosophy or views on soil erosion of its suburban owner, his compost heap defies no chemical or other natural laws. It is simply a plant food factory run by an unpaid microscopic staff, a biological invention which can be compared to domesticating animals, making cheese, brewing, or silage; a product of man's intelligence in harnessing Nature to his needs, as natural as a culture of penicillin. The main problem of using this process is one of economics, and in the garden employing no labour other than the owner's, this means 'Will growing my own plant foods be so much trouble and take so much time that it will not be worth the effort?'

The answer is that where the normal rubbish revenue of the garden is composted, the time spent is more, but not very much more, than by orthodox bonfires and straight tipping on an unsightly rubbish heap. The trouble is the same whatever the size of the heap, and, as with Atom bombs, the smaller

sizes are the most difficult to make well. Bad compost takes as much time and trouble as good, but produces much time-consuming weeding from the great crop of seedling weeds that are the result of insufficient heating.

The main summer revenue of a normal garden, the season when compost is easiest to make well, is in weeds and lawn mowings. In the autumn there are much larger quantities of cut-down herbaceous plants, dead leaves, tomato haulm, frosted dahlia foliage, etc. available, less easily rotted, but giving the greatest bulk.

The addition of a 'Comfrey Corner' to any garden means a great increase in summer compost material rich in minerals, in bulk cuts between April and November roughly every six weeks, and producing far more for much less labour than successive crops of mustard, with no unheated seed risk and without the fall in production that strikes the lawn in a dry summer. As it can use often unproductive garden space, it keeps this tidy and largely weed free, as a permanent asset.

The site can be in shade from buildings or trees, but not under fruit trees; the nitrogenous manures required and the robbery from the roots cause difficulties. In shade the production will be lower, the ideal site is in full sun, but provided it is not excessively dry and beyond the reach of a hose one can use almost any position; the plant will produce the greatest quantity of foliage of anything that will grow there, not excluding nettles.

Thin soils over rock, a buried concrete floor, or where chalk is within a few inches of the surface are to be avoided, because the plant needs room to drive down its roots; a deep soil, even poor and pebbly, is always best, and a heavy clay or subsoil is ideal. A steep slope is undesirable, not only because of cutting difficulties, but because of drought. Once the roots get down far enough to tap subsoil water this is less important, but where a steep bank is the only place this should be levelled off and planted only on the top, a dry-wall or rock bank being used to retain the soil. Whatever the site it should be permanent, for though Comfrey can be moved at any time during its growing period, the broken ends of its roots, even the smallest fragment, will grow.

It is the struggles of the neglected root fragments from the past in old gardens that give Comfrey its reputation as a weed; though seed is so rarely set that this risk is trifling; moving the plants about is as fatal as planting them in the herbaceous border. For the benefit of the large class of Undecided Gardeners who are never happy unless their garden is remodelled every autumn, and those so new that they have not learnt the value of leaving things alone, here is

how to kill Comfrey. Mark where it is growing in the autumn, then in December or January dig it up with as much of the root as possible, leaving the ground rough. The disturbance and the frost at its dormant period will rot off the remaining roots of the Russian species. Our native *S. officinale* is tougher, and so are some of its natural hybrids with the other species. These will probably appear again in late spring or early summer. Dig up again, going down as much as eight inches; if necessary do this three or four times, and the buried roots will die of exhaustion, but only if the leaves are not allowed to develop and send reinforcements of carbohydrates down to the buried fragments. A summer's careful weeding will destroy the toughest and the fragments should be burnt, or in the case of a good variety, planted where they are required. Never hoe any Comfrey, the buried root will merely grow again, and the chopped-off fragment may have enough root on it to make a further plant. A weed is a plant in the wrong place; the wild white clover, cherished in a pasture ley, is a weed on the tennis lawn and a curse on the rock garden. Russian Comfrey needs to be kept in its place, in the Comfrey Corner.

This should be prepared by digging thoroughly to remove the roots of all perennial weeds, especially couch grass, creeping thistle, dock, creeping buttercup, dandelions, and convulvulus. If the ground is poor, manure of some kind is an advantage; a dressing of two ounces to the square yard of bone meal, or a general fertilizer such as National Growmore, is a help in giving the new plants a flying start. The time to establish the corner is either between September and the end of November, or between the beginning of March and May. Plant the offsets, which should have a growing point on each, with this just below the surface; three feet apart each way if the soil is good, that is in full sun on ground that has produced good vegetables, or closer, down to eighteen inches apart, in places where nothing much will grow.

They will need hoeing shallowly for the first few months, but they are essentially a 'no-digging' crop. The swift growth and constant cutting prevent much weed-seed formation, once the stored seed in the surface layer has germinated; there is no point in bringing up more that is safely buried. Cutting is done when the plants are about two feet high on poor soil; on rich they can run up to three or four, but there is no gain in leaving the plants till the flowers are over; the aim should be to keep the plants looking like those illustrated in Fig. 3 and Plate 5. Shears can be used, cutting two inches from ground level; or a sickle (bagging-hook, reaping-hook, the name varies all over Britain, but it is the tool associated

politically with a hammer), or on a larger scale, the type of motor scythe used for cutting rough grass in orchards.

The best routine is to cut one evening and to make one's compost heap the next, or in the morning, when the crop will have lost roughly 20 per cent of its moisture by wilting and be in ideal condition. Gathering is a matter of a garden fork and a barrow; wheeling heavy loads make nearness to the compost heap an advantage to be considered in selecting the site. An average of 7 lb. per cut per plant, which is a usual crop on good soil the second year, means roughly 2 cwt. for 50 plants, six times a summer.

Manuring to obtain and increase this yield, particularly on poor soil, is necessary. Those who have poultry have no problems; they can fork on very roughly four ounces a square yard of fresh droppings in the spring between the plants, and give another application between cuts about July; give lime at the rate of two to three ounces a square yard in November, and leave it to Nature. The 'burning' effect of the excessive and rapidly available nitrogen in fresh poultry manure cannot harm Comfrey as the roots are down out of harm's way and they can take their nitrogen crude. Many struggling weeds, however, will suffer from the burning.

Where poultry manure is used exclusively for a long period, such as five years, balancer dressings of potash are essential, transposed on this small scale to one ounce of sulphate of potash (muriate of potash only if the other is unobtainable) to the square yard. The true organic gardener, and those who dislike buying what they can supply from the garden, can use wood ashes. Fruit-tree prunings, because the younger shoots always have the most potash, leave ashes that are roughly 25 per cent potash in available form, so four ounces of the grey product of the bonfire, stored in the dry and never rained into the flattened disc in the middle of the circle of unburnt ends, replaces the ounce for each square yard. Softwoods, as from burnt shavings and the by-products of modern carpentry, contain less potash, about 15 per cent, so a six-ounce dressing is about right.

This is for pure wood-ash, not that from a normal bonfire which will contain much burnt earth and be so variable that the allowance will be a matter of guesswork; it will not in any event contain more than hardwood or prunings, so to be on the safe side six ounces should be the maximum. Coal ashes are unsuitable because of the quantity of sulphur contained, and as a town soil will contain more than enough from soot and the washings from smoky air, it should never be applied. The autumn lime-scattering should be at the rate of from four to six ounces per square yard, which should keep a town soil

in good condition, but not if coal ashes are used. The heavy clays where these are of value as a lightening medium usually contain sufficient calcium to prevent this trouble, but even then coal ashes add no plant foods, and so far as Comfrey is concerned, have no value.

Those who do not keep poultry can secure the same effect, without the need for balancing potash, by using the dried poultry guanos such as Gunos or Poultmure at the rate of three ounces per square yard in the spring, and again at midsummer, with liming as before. The idea is to apply a high nitrogen general fertilizer when the plants are growing strongly, not in winter when they are dormant, and of these dried sewage sludge and dried blood are both excellent, the last at two ounces to the square yard as it is both richer and more expensive. Compound general fertilizers, such as Clays and others, should be used as directed for general vegetable crops for the whole season; the extra July dressing is advised because so much is coming out of the land.

These manurial systems apply to poor town gardens where fertility must be built up, or to sandy or stony soils low in plant foods. On fertile land, such as a vegetable garden that has been well treated, very heavy crops can be taken for as long as three years without any added manures of any type, but it is as well always to err on the side of generosity.

After the last cut the Comfrey Corner is left for the winter, the only other cultivation measure is a search with a strong fork to dig out any perennial weeds that may have seeded or developed from root fragments. The whole growing programme is simply 'keep it clean, keep it cut, keep it fed'. It then thrives happily for years in the most unusable of corners.

The making of compost with Comfrey differs in no way from that of any other green crop, except that one has much more to use. The beginner, or the man who is not interested in organic gardening, can simply buy one of the proprietary activators and use it according to the directions. He will make sufficient of a product considerably better than the manure sold expensively in towns by men with pony carts, and will make a very valuable improvement in the fertility of his garden.

Those who wish to make the very best compost will find full accounts in *Compost* by F. H. Billington (Faber & Faber, 5s.) or the cheap and excellent booklets published by The Soil Association, 8F Hyde Park Mansions, Marylebone Road, London, N.W.1. The following is an account of the modified Indore system (so-called because discovered by the late Sir

Albert Howard at Indore Research Station in India), used by the writer.

Choose your heap site in a place sheltered from wind and out of the way; high and dry, not where surface water will drain into it, and not on any account a pit sunk below the surface of the ground. The best place in a small garden is the angle of a garden wall so that an additional wall of rough brick or thick old timber (not creosoted) four feet high makes an enclosure, which with a temporary solid 'gate' at the open end does away with any need for a soil covering. Further extensions can be added, with only one wall and one gate. The object of these walls is to provide heat insulation; corrugated iron is not only unsightly but very poor insulation, apart from rusting; concrete is good but, like death on the road, so permanent. Excellent heaps have been made in old pigsties, with earth, but not concrete floors, because of drainage; in old frames, the base brickwork of old greenhouses and, with one side replaced with removable woodwork, those most inconvenient brick-holders for garden rubbish found in some old gardens. It is essential to be able to fork in easily straight from the barrow, and to shovel out, even if the compost is not turned. Failing these the heap is made tapered at the top and covered with a three-inch layer of earth at the sides and top, like a potato clamp. As soil on this scale is scarce in most gardens it is removed, stacked, and re-used year after year. The minimum successful size is a four-foot cube, and six by six by four is better, while a long heap six feet wide is better than a larger square. These dimensions are determined by the needs of air supply and heating losses in proportion to surface area.

Start with a bottom of old bean- or pea-sticks, rough brushwood, or hard rough clinker with plenty of air spaces; it will be awkward for the final shovelling but worth the trouble, because the amount of heat generated is going to use just as much oxygen as if it had been produced by a coal fire. Those who compost sewage sludge (see the next chapter) use agricultural drain-pipes set with half-inch gaps between them in lines running herring-bone pattern, or use hollow air bricks. If these are available in any form but metal, use them running in lines from the open end. Double rows of old bricks with broken slates or tiles on top are also good, and these are all easy to pick out for re-use. Then plant at intervals leading from these, or down into the layer of brushwood, stout stakes about two feet apart, to be withdrawn afterwards leaving upright air channels. When a heap is made at one go, the rakes and hoes can be loaned upside down for this purpose.

Then start with a layer of compost material roughly eight inches thick, sprinkle or fork on the activator, roughly four ounces to the square yard of surface if dried poultry manure (excellent, either air or superphosphate dried), or one or two inches thick if fresh and wet, or if pig dung or farmyard manure is used. Then another eight inches of material, then sufficient slaked lime or ground chalk to whiten the whole surface, either will do. Slaked lime is calcium hydroxide and there is enough carbon dioxide released in the heap to convert it to calcium carbonate which is chalk, so its action is the same, that of keeping the heap from becoming so acid that it prevents further decay, and it favours the aerobic or oxygen-breathing bacteria, which include the best nitrogen fixers.

Another layer of material is added, then a further layer of activator (the proprietary brands contain the necessary lime or other bases, and with these the sandwiches are single instead of double-deckers) and so on to the desired height, four to six feet at the start, finishing with a two-inch layer of soil as a heat insulator. The stakes (or borrowed tools) are withdrawn and the holes plugged with wisps of straw or grass, to keep the loose earth from falling down them.

In summer the temperature rise will be swift. Special thermometers are sold for testing it, but the added nitrogen in the dung plus the swiftly available phosphates in organic form, which gives this method a great advantage over chemicals, can be relied on to secure such rapid bacterial increase that the heap will, if made in May from all soft vegetation, be ready for autumn use. Readiness can be judged by its being completely cold, and by the presence of those small red worms that Isaac Walton preferred for bait. With an enclosed heap of this type (the 'New Zealand Box' of Compost writers is exactly the same) there is no need to turn; the function of turning is to bring the undecayed material that has not heated because it is at the sides, into the middle, and it is necessary only for a soil-sided heap, or one where diseased material such as blighted tomato haulm has been used, or where some of the vegetable matter is very tough, such as sawdust.

With Comfrey compost it is a good idea to mix the wilted stems with the grass mowings, weeds, and domestic refuse. Potato peelings, dead cut flowers, tea leaves and everything that would normally go in the dustbin, except paper, anything meaty or greasy or containing disinfectants, or solids such as bones, should go into the heap. Vacuum-cleaner dust, with its high proportion of fluff containing nitrogen, is of special value. The thick stems serve to keep

open the air spaces and prevent any ingredient clogging up in a solid mass. The bulk of material from a Comfrey corner means that sufficient heat is available to cover up and cook into odourless safety all this type of rubbish. The gain for the garden is considerable and apart from getting rid of refuse in the country, if every gardener in every city did it, the saving to the rates would be considerable.

Winter heaps, made in the autumn, are built on the same principle. The last cut of Comfrey should be mixed in with the dead leaves that clog together like the pages of a book, and fresh poultry manure is an even greater advantage. Poultry manure contains, when fresh, nitrogen in the form of urea broken down to ammonium carbonate, which favours Hutchinson's spirochaete, the bacterium which normally lives on straw and the quickly wasted liquids of the farm-yard. This creature is the finest converter of hard fibres to humus of all; even straw and up to 10 per cent of the total bulk of material of sawdust or spent tan bark, can be included with a poultry manure activator. Bulky material such as tomato haulm or Michaelmas daisy and dahlia stems, is improved by being run over by the roller on a hard surface; a small motor mower is excellent for this job.

There is no difference in the process, except that sheets of corrugated iron above the heap as a shelter from excessive rain or snow are an advantage; if heat must be spent on evaporating moisture, the upper layers will not get hot enough. In frosty weather the air vents will puff steam like traction engines. Decay will not be so swift because of lower outside temperatures and tougher material, and a spring turning to bring the heap sides to middle is advised. This is best done into another enclosure and can well be about February before one is really busy in the garden. If the material is at all dry, water from a rosed can should be given. After a second heating the compost, which will have diminished greatly in bulk, but not as much as would a summer heap, will be ready for use at midsummer or in the early autumn.

Though farm-scale methods of increase can be used, Comfrey can be propagated in great quantity by root cuttings, without any risk of it spreading to other parts of the garden. It should be remembered that though a few dozen plants can be multiplied by geometrical progression, every time they are dug up the yield is reduced to first-year quantity the following season, and the big weights come from three-year-old and older plants.

Select a good plant or two at the end of the first season when they are in full growth. Comfrey, as we have it, is not a

species that is fixed and unvarying and, therefore, by increasing vegetatively only the best, we can improve yields. The ideal plant is one whose flower-stems when cut are solid, without a hollow in the centre, and that has consistently given heavy cuts. Dig up the plant in March with as much root as possible; it should be labelled in November so that it can be identified. It will be necessary to go down at each side as though lifting a fruit tree, to get the main taproots out. It will resemble a giant and very fangy dock, and the first part of the programme is to cut up the crown to make offsets, one for replacement and the rest for extensions, to give a crop during the same year. These are sliced out of the mass of growing points, each with about four inches of old root with it; this old root can have three sides cut surfaces, drastic treatment does no harm. For immediate cropping the growing point is essential; Messrs. Suttons rightly insist on this in their 1878 Farm seeds. Catalogue, and it is the reason why the crop is relatively expensive. You can multiply only by about six good offsets the first year, apart from farm-scale increase from old plots.

The major increase, for cropping the following year, is secured from root cuttings. Cut up every fragment of the remaining roots, into inch-long sections, and where these are over an inch in diameter, as the upper ones will be, slice them down the middle to make two. These can then be 'sown' along a furrow an inch deep and covered over with soil, in a part of the garden where there is no objection to Comfrey, as a reserve nursery bed. The furrows should be about a foot apart to allow for hoeing, and the aim should be to have two inches between each root cutting. Not all will grow but 90 per cent will flourish, appearing about June on a greatly reduced scale. A single cut, in August, to increase root action is advisable, and the plants are left until the following March, when they will be good offsets for cropping the same year. Total increase depends on the root vigour; a hundred root cuttings have been obtained from one plant.

PROPAGATION AND MODE OF CUTTING PRICKLY COMFREY SETS.



Root-Set.—This is a section cut off a tap root, and if placed in soil with the small end downwards will throw a large number of heads, which do not always bloom the first year, but yield a large crop. Another plan is, to place the sets in a damp sack kept warm and moist in the dark; shoots are thrown out, and when $\frac{1}{2}$ -inch long the sets may be planted, and the shoots will bloom the first year.

Crown-Set.—This is taken from the root of the plant near the surface of the ground, and the smallest piece forms a crown-set that blooms at once.

Fig. 6

Root cutting and crown reproduced from Thomas Christy's *Forage Crops*. The crown on the right has about the maximum cut surface and both are natural size, but the smallest for success. Large pieces are better

An alternative system is to fill kipper-boxes or other deep trays three-quarters full with soil, set in the root cuttings, and fill up with soil. These are watered and stood on concrete or a hard path. They will also make plants for the following spring; smaller because of the restricted root room, but with the advantage that the Comfrey is kept strictly in its place. This method is more trouble, but the only normal precaution that most gardeners need worry about, is to do the root-cutting-up operation on sacks or newspapers and to empty the remains either in the dustbin or on to the Comfrey nursery bed. Where they are not required, the very smallest roots will grow. It is in general better to increase by this intensive method, lifting a few plants and making the most of them, than to disturb a whole Comfrey corner.

An even more valuable use for the Comfrey corner is as a supply of greenstuff the whole summer for domestic poultry, either with or without a compost heap for the surplus. It is

just as profitable to cash in on the high protein to fibre ratio and great productivity of the plant on a backyard scale as on a poultry farm.

The smallest number of plants to start with is thirty, giving a cut of one a day, though as they increase in size there is nothing to prevent cutting half or less. With seven-pound plants in the second or third year, and three ounces per bird about the maximum they will eat in a day, there is soon a balance at the end of the month for compost, which can run on for another fortnight as there is no need to aim at high protein for the heap. Poultry will clean more Comfrey than they can possibly eat, about 24 square yards per bird, and the minimum backyard run space recommended by the Harper Adams College is 25 square feet, a space 5 feet long and 5 feet wide. It is therefore possible to wire in the Comfrey corner, providing green-stuff only when the plants are small, and compost as well as they increase.

The space needed for thirty plants only, three feet apart in six rows of five plants each with eighteen inches of space at the ends and sides, is fifteen feet by twenty-one feet. This is enough for twelve birds, and as soon as each cut averages three pounds per plant easily (and the Rev. E. Highton got six pounds his first year in good garden soil in 1875), their entire green food ration is supplied from this minimum run area. It is better, if space allows, to make two runs, either with fifteen plants in each and the balance bare land, or further plants for compost, so that they can be used alternately. As spring planting has a considerable spread-over, the first run can be planted in March with the birds in the second, so that the Comfrey will be up to cutting size and beyond injury risk from being pecked at when very young by late April. Then the birds are turned into the planted run, and a further batch is bought to stock the empty one. Autumn planting is not recommended, for though the poultry do not harm dormant established Comfrey in winter, they will scratch up and eat new-planted crowns before these get a root hold.

Where green food is grown in the poultry run on this intensive scale, no manuring is necessary; about half a hundredweight per bird is going on each year, and this, if anything, is too much except on poor soils. Lime should be used generously, and also balancer potash or wood ashes every year. The resting run is treated on the normal routine, dug over with a fork between the plants and rows, keeping about six inches away from the plants (as when digging the herbaceous border) with the birds grabbing for worms: leave them clucking and raking happily for the rest of the day, and

turn them into the fresh run in the morning. As the crop of weeds in the rested run is merely a change of green food, there is no disadvantage in abandoning the 'no-digging' idea; one has dug to turn under the dung and to avoid the risk of dropping-carried disease, for the benefit of the poultry, and on this scale as in any backyard run it is essential. Wherever poultry are used as weeders on a garden scale manure dressings are only required on very poor soil, and their need is best judged by the crop. If one year the production is low from an established plot, then give an additional spring composting or manuring. The balance of poultry manure on dropping boards can be reserved for the rest of the garden, or as a compost activator.

The easiest feeding system is to cut the daily ration after the birds are shut up, and leave it to wilt overnight for them to attack when they are let out in the morning. It can be hung up for intensive birds, and is quickly cut and fed for deep litter and other systems. Chaffing Comfrey, after wilting for twenty-four hours to lose up to 30 per cent of the moisture, is only necessary when it is fed as part of a mash, but it is well repaid if the machine is available, as it then becomes almost a 'concentrate'. It is again stressed that as the fibres are few but stringy, it is suitable only for birds that have got beyond the chick stage, six weeks old at least, to avoid the risk of crop trouble. Though wild rabbits and tame will not eat the plant growing, it is excellent fed wilted, and once they are used to it this is a very useful green food for tame rabbits. This is from modern rabbit-keepers who consider it superior to cabbage.

With unlimited poultry manure on land that begins as a good vegetable garden, it is likely that the amateur will achieve yields that would be impossible on a farm scale; 10 lb. a plant as an average, with 15 lb. big ones to level out the 8's and 7's, means 39 tons per acre per cut, and even six cuts at this rate yield over 200 tons. The Bishop of Kildare who owned the Carnew Castle plot in the 1830's was asked what it would yield under these conditions, and replied: 'Sir, it will produce 300 tons an acre.' (Quoted from *The Cottager's Cow* by Kinard B. Edwards, about 1873.)

Though some saving of expensive meal will be possible with this unlimited fodder, because it is entirely unlike brussels sprout stems, cabbage-stumps, and any other garden green-food in not containing a large quantity of fibre with its protein and carbohydrates, caution is necessary. The fowl is omnivorous, eating insects as well as grain and green-stuff, and therefore animal protein is required, and its lack means feather-picking and other vices. A diet of wilted Comfrey and

kitchen scraps is going to mean a fall in egg yield, and therefore alterations in the diet should be made only when experience has shown the safe saving.

Those who rear their own replacements may well find that it pays to take fewer eggs per bird and keep more birds, as poultry food increases in price, by supplying the maximum of easily-grown green food to save bought concentrates. It is also possible that table cockerel fattening, on Comfrey and scraps, will also be profitable in terms of meat from garden space and time, though both would be out of the question commercially.

The saving in effort on all other forms of green food, even apart from quality, makes Comfrey growing of value to every poultry-keeper. When this is combined with the clear gain of using the ground required as part of the run space, and avoiding the need to buy seed or plants or even collect weeds as green fodder, it is even more worth while investing in the crowns than it was in the days of Kinard Edwards, who first saw the small-scale possibilities of the crop. There is no garden method of preserving the crop for winter poultry food, so Hungry Gap or Thousandhead Kale, which are

128

Russian Comfrey in the Garden

the hardiest, should be grown to fill in the green-food needs for the period when Comfrey is dormant.

Comfrey has been used as a vegetable, usually by cooking like spinach, using the young leaves in early spring when they first come though at a time when green-stuff is scarce. The following recipes are modified for modern conditions from originals in the 1880's:

COMFREY SOUP

Make a white sauce with 1 oz. margarine, 1 oz. flour and 1 pint of milk, add 3 to 4 tablespoonfuls of sieved Comfrey (cooked first like spinach), 1 teaspoonful or sieved or other meat extract, salt and pepper and $\frac{1}{2}$ pint of water. Bring to the boil and serve.

COMFREY SOUFFLE

Make a white sauce as above, cook until it leaves the sides of the saucepan, add 4 to 5 tablespoonfuls of sieved Comfrey, beat in one after another the yolks of three eggs, and finally fold in the whites. Bake in a soufflé dish for 20 minutes. Recommended for poultry-keepers only.

COMFREY AU GRATIN

Wash and cook young comfrey leaves in boiling water to which 1 tablespoonful of bicarbonate of soda and salt has been added. Sieve or chop when cooked. Put a layer of cooked rice on the bottom of a fireproof dish, and a layer of comfrey, a dash of Yorkshire relish, a handful of grated cheese and a few dabs of margarine. Repeat till the dish is full, finishing with rice and cheese. Put some margarine on top, and fill it up with milk or milk and stock mixed. Bake in a fairly hot oven for about 30 minutes and serve.

CHAPTER VII

Municipal Composting and Russian Comfrey

One of the basic problems of civilized man is that he has conquered the water-borne diseases at the expense of pouring large quantities of plant foods through his sewage systems into the sea. We can, by spending electric power on a considerable scale, or growing leguminous crops, restore the combined nitrogen from the vast 'sterling area' of the atmosphere, but the 'hard currency', the potash and phosphorus, returns only on a limited scale as fish, and of this all but a fraction is immediately wasted again. Primitive man avoided the problem by stocking his living area with himself at the 'free range poultry' level for human beings; in larger communities he runs exactly the same risks of infection as the grazing animal, and many of our sanitary customs and prejudices are rooted in valuable instinctive precautions.

The sterilizing heat of the compost heap has been a partial solution in the Chinese civilization and compared with its success in maintaining fertility its imperfections are small. The problem, which will increase with rising populations and the exhaustion of mineral fertilizer deposits such as rock phosphates, is how to secure the advantages of both worlds at the lowest economic cost and inconvenience.

In many tropical countries where water supply is also a difficulty, as in South Africa, direct composting on the Indore system with raw untreated sewage and swiftly growing tropical vegetation plus house refuse, has banished both the fly and the disease problems, and restored to the land the manurial value otherwise wasted. Even with modern water systems, the effluent has been used in shallow tanks to grow the water hyacinth (*Eichhornia crassipes*), a drifting weed whose roots extract the plant foods in solution and make the water sufficiently pure for discharge into rivers. The plants are such rapid utilizers of dissolved materials that they have become a serious pest in many American and South American rivers, by blocking the waterway to ships. In South Africa they are raked out, dried in the sun and composted with sludge. At local wage rates the system is profitable, but the water hyacinth will not grow in the temperate climates where the greater part of the water-borne sewage waste takes place.

In Britain, the utilization of sewage has almost as long a history as Comfrey, and the efforts of Alderman J. J. Mechi to popularize a system of irrigation by pumping, at one time produced many 'sewage farms'. The capital cost, the limitation that the irrigation must go on, winter and summer, when it can only be utilized by crops for part of the year, and the rise in population, prevented its extensive use. Sewage sludge, usually dried by pressing, is sold to a limited extent for agricultural use, and it is the basis of some compound fertilizers. The manurial value of the modern sludge is very low, containing only traces of potash and only about 2 per cent each of nitrogen and phosphoric acid, because it is merely the by-product of biological and mechanical processes designed to break it down to simple elements as rapidly as possible in the interests of public health. It has, however, been used successfully to make compost from surplus straw, gaining both humus and potash as well as combined nitrogen when it is used as an activator. The Ministry of Agriculture Bulletin 'Fertilizers and Manures' gives a very good account of the process.

Highly successful composting of domestic refuse and sludge has been carried out by the Dumfries County Council, and their experimental plot has demonstrated the value of Russian Comfrey as a substitute for the water hyacinth and the Kudzu grass for temperate and cold climates.

The Dalscone Road sewage treatment works at Dumfries handles the sludge collected from the sedimentation and nitrification systems, and septic tanks serving nineteen small rural areas with a total population of 3,850, and produces saleable compost of high manurial value in batches taking from twelve to sixteen weeks to mature. This is sold at 30s. a ton in bulk and 10s. a cwt. dried and bagged for rail transport in small quantities. Part of the old beds which were used for air-drying sludge provides the composting space, and the process needs only half the area of this now uneconomic method, and allows a considerable reduction in capital cost for new rural schemes. The extra labour worked out at approximately £300 a year, and much of this went on bringing in materials for composting.

The system is basically as described in the last chapter, replacing the brushwood bottom with open-jointed drainage pipes and cross slats of timber in the first beds, where the sludge is mixed with the refuse. This includes paper and sawdust in bulk as well as the dustbin contents, and the primary heaps where decay takes place, are drained by pipes of the same type laid two feet apart under beds of clinker. Screened 'dust', which, of course, is mainly the ashes from

house fires, has been used successfully, but not more than 50 per cent of the materials can be this type of waste, though it is valuable in soaking up surplus moisture.

The process is fully described in the booklet 'Interim Report on Composting' by J. C. Wylie, B.Sc, A.M. Inst. C.E., which is available from the County Engineer's Department to serious inquirers.

The product varies with the season, but the following analysis in comparison with F.Y.M. shows that it is extremely good value at the low rate at which it is sold:

Analysis of Municipal Compost, Dumfries Corporation

| | <i>Moisture</i> | <i>Mineral</i> | <i>Organic</i> | <i>Nitrogen</i> | <i>Phos- phoric</i> | <i>Potash</i> |
|-------------|-----------------|-----------------|-----------------|-----------------|-------------------------|-----------------|
| | <i>Per cent</i> | <i>Matter</i> | <i>Matter</i> | <i>Per cent</i> | <i>Acid</i> | <i>Per cent</i> |
| | <i>Per cent</i> | <i>Per cent</i> | <i>Per cent</i> | <i>Per cent</i> | <i>Per cent</i> | <i>Per cent</i> |
| F.Y.M. | 74.00 | 10.00 | 16.00 | 0.60 | 0.40 | 0.50 |
| Compost (1) | 13.06 | 14.90 | 72.04 | 1.25 | 0.60 | 0.50 |
| Compost (2) | 20.00 | 48.00 | 32.00 | 0.97 | 0.48 | 0.50 |
| Compost (3) | 18.77 | 33.90 | 47.33 | 1.64 | 1.00 | 0.20 |
| Compost (4) | 49.00 | 22.44 | 28.56 | 1.24 | 0.70 | 0.29 |
| Compost (5) | 61.58 | 9.60 | 28.82 | 1.06 | 0.40 | 0.20 |

Sample (2) was made with screened refuse in high proportion; the others were mainly waste vegetation, straw and sawdust.

The major problem with this type of composting is that screened refuse, sawdust and such waste industrial materials as tan bark or spent hops, bind together in the heap, excluding air and preventing complete decay at sterilizing temperature, which gives the process its hygienic value. At Dumfries, where roughly 3,000 gallons of crude sludge go to 1½ tons of coarse material and 25 cwt. of screened dust, plus about 30 lb. of neutralizing agent (lime, chalk or wood ash), third-day temperatures run even higher in some cases than the normal 160° F.

Roadside cleanings, bracken and waste straw are available in Dumfries because of local conditions, and the lack of material of this kind in other districts is one of the reasons why the system is not more widely used in industrial or residential areas. In 1951, Mr. J. C. Wylie planted a trial plot of a hundred plants from the Southery stock of *Symphytum peregrinum*, to see how far its growth speed and production from a small area would go to solve this problem and save transport costs on collection.

The method found most successful was to wilt in the field for twenty-four hours or longer to produce a kind of semi-hay, sufficiently stiff to hold the material with which it would



16. On a small scale, cutting with a reaping hook and carrying away the ration on a split sack is cheaper than by tractor with mower and buck-rake.

16. On a small scale cutting with a reaping hook and carrying away the ration on a split sack is cheaper than by tractor with mower and buck-rake.

be combined slightly apart but very readily decaying and spreading through the more refractory matter, its aerating effects ensuring rapid bacterial increase. This type of wilting is largely independent of weather; the first 15 per cent or so is the result of the continuing growth processes of the plant, and losses as high as 50 per cent can be achieved, without the difficulties of drying the stem centres as in hay-making.

The experiment was purely to find out the qualities of the plant as a compost material under a system such as the Dumfries system, and, as always with a small plot, it was allowed to flower, and with only three cuts a year the yield was low. The first cut of the second year worked out at over nine tons an acre of dried material, but the moisture was not determined, so this cannot be compared with agricultural yields. As its moisture content was certainly over 25 per cent down, it is interesting to compare it casually with the unwilted yield figures of the Hannah Dairy Research Institute in the same area for a whole year.

The only manure given was a dressing of the sewage works compost, and so far no work has been done on the possibilities of exploiting the growth speed and rapid plant food intake of the crop as a kind of temperate-zone 'water hyacinth'. Compared with orthodox sewage farm crops of the past, Russian Comfrey would take more crude sludge over a longer period than anything, and its production capabilities



17. Loading Compost at the Dalscone Sewage Works, Dumfries County Council. Comfrey provides ideal carbonaceous matter and improves the potash content of this valuable organic manure.

on a poor soil, with unlimited nitrogen and water in the eight months' growing season, are entirely unknown. It would also be of value where there was difficulty in selling pressed or air-dried sludge. A plot dressed heavily with undried sludge would produce a bulk of compostable material in successive cuts at low transport costs, leaving the balance of the year to surplus straw and dead leaves, apart from household refuse for both periods.

Experiments by borough engineers and those in charge of the small sewage plants at isolated hospitals and institutions could convert the theory of this chapter into practice, but in an unknown field it is only possible to suggest developments in the hope that others will venture on where there is no highway. The labour involved in growing the crop would be less than for any other vegetable matter, and even though a municipal poultry farm to run weeding birds through the crop

would be inconvenient, the greater growth speed from heavy manuring and frequent cutting would mean fewer weeds; an occasional mechanized hoeing both ways after a cut would keep the middles clean. As one would be taking eight complete cuts a year, not a daily stock ration, this job could be done by contract. The planting and management of the crop would be exactly the same as on the normal farm, with the difference that experiments would be directed to discovering how much manure, in this case sludge, the crop would take to give maximum yield, not how little. Balancer dressings would need to be worked out because these would vary both with the soil down to the eight-foot level, and the potash content of the sludge. In the case of the lime precipitation sludges this element would be secure, but with other systems the use of a soil tester at intervals might well be required, and heavy limings necessary.

Sewage sludge in normal agricultural dressings has been given to Comfrey with good results; the high nitrogen compared with farm-yard manure's is especially useful, in exactly the same way as with poultry manure, and on clays the low potash would cause no difficulty. Shortage could arise on the very poor sands where sewage manuring would give the greatest benefit, and the value of the crop in these circumstances would well repay balancer dressings.

Sewage effluent has never been tried at all, and it is possible that industrial wastes and foam-producing detergents unknown to Alderman Mechi would rule it out completely. A semi-hydroponic tank full of cinders or sand, planted with Comfrey and sufficiently firm to allow a wheeled tractor on for cutting, irrigated with effluent, might well be as useful as the water hyacinth in South Africa, with the added advantage that the sterile growing medium would cut out the weed problem except for blown seeds. All modern methods in this field are directed to restoring to the air or directing into the sea or a river, as much as possible of the plant food elements, both from our own land and those of other countries. Experiments to see if there is any possibility of restoring at least some of the manurial value to the land, without either danger to health or totally uneconomic cost, through this new application of an old crop, would be well justified.

The farmers, and many others who are not convinced that humus shortage is the cause of all disease or nutritional trouble in plants, stock and human beings, and compost their cure, may well wonder if there is not some better way of utilizing the wilted product of intensive manuring at the sewage works. Fodder, wilted down to 65 per cent moisture

with 9.5 per cent protein, 13-8 per cent starches and sugars, and still only 4.5 per cent fibre, should be worth more as food for stock than bacteria in the compost heap, especially as it would have had no direct contact with the sludge, which is in any event completely innocuous after modern methods of purification.

This, however, would cause difficulty under the Acts that control municipal enterprise. Should the growing of Comfrey be essential for the efficient disposal of sludge by composting, and there be a surplus quantity of the crop accumulating, then a council can dispose of this surplus by sale, but there are no powers for the actual growing of the plant solely for sale as a feeding-stuff. Otherwise there would be a prospect of either municipal silage or hay-making, both considerably simpler than compost making, or letting the rights to cut and carry, at a profit to the rates in rural areas. Eight cuts of even 10 per cent protein hay stored in a dutch barn are an asset that would be appreciated by many parish councillors.

This difficulty does not apply to any privately-run sewage plant, though the local sanitary inspector would need to be consulted as a precaution, and for his advice. The drainage would need strict attention, because soil sourness is to be avoided at all costs, and a quick run through as on a sandy soil is desirable. Were effluent used on any scale this could cause complications in some subsoils. No such problem arises with the use of sludge, which can in some cases be obtained free or at a low rate if carriage is paid.

Though it is likely that the rapid growth would mean a more sappy crop, wilting is also increased in speed and there would be a considerable gain in dry matter per acre from this 'forced draught' production. The optimum amount of the dressings or irrigations is entirely unknown; judging by other plants and other manures, there would be an ideal quantity, a flattening of the curve with further additions producing no gain, and a falling yield from excess. This would vary with the seasons, and the greatest applications would probably be possible at midsummer, when growth was at its strongest, with lower maxima in early spring and late autumn.

The problem is one of digging up an old idea of sewage utilization out of the past, and finding out whether new knowledge has put value on to it in the modern world. This type of experiment is as common in industry as the development of entirely new processes, and there are many successes, as well as failures, from increased material and labour costs or new difficulties. The need is to avoid discouragement by quotations from textbooks between twenty years and a century old, and to try on a modest scale, but

with sufficient perseverance, to rule out failures due to some minor fault in technique in an unknown process, at any stage between crop and consumer, as compost or stock feed.

CHAPTER VIII

The Future of Russian Comfrey

The future of this crop can either be the repeating of the familiar pattern of the past, or an entirely new departure of special value to Britain in particular, and perhaps to a world whose progress may be towards greater hunger, rather than the cosy visions of swifter travel and space ships we share with younger and more optimistic nations.

The trodden path is for this book to become a quotation mine, out of which those who sell plants whose agricultural value may be less than those described, will pick their advertising matter. Purely because it is more recent and more easily found, others will rediscover the plea of the Irish farmer for someone to tell him how to 'get rid of it', and use these pages (and the Bibliography) as a ready means of finding everything that can be said against this crop. On current form over the last hundred years this book will make a small ripple, splashing into letters in the farming periodicals, a nine days' wonder on a small scale, and then go on to the topmost shelf of all, with the works of far older and better men. Someone will climb the grandchild of the long ladder in the lofty R.A.S.E. Council Chamber that may still house the library in 2053, blow off my dust in triumph, and start the cycle again.

Yet why has this crop remained the only one in which some yields per acre recorded in 1946 are roughly a tenth of those in 1846, the only one in which progress has been backward and research almost non-existent? Why has it captured the efforts, the imaginations, and the pens of so many small and practical farmers in direct reversal of the normal pattern of agricultural research; first making a discovery and then striving to encourage its cultivation or practice?

The answer is fiscal and financial; rather than due to any intrinsic bad qualities of the plants with which we are concerned; Comfrey's decline is not due to any mythical monster of a 'vested interest', but purely to the handicap of a peculiar flower structure.

Research into insecticides, fertilizers, compound feeds (including growth hormones), selective weed-killers, even farming machinery from grass driers to poultry-plucking machines, everything that is used on the land but made by industry, has behind it the resources of heavy taxation

against which payments for future development work and subsidies to approved institutions are allowed as trade expenses; a wise provision of great value, both to the land and the balance of trade from the exports that result from these discoveries. It means, however, a strange bias in the selection of the problem we endeavour to solve by experiment and accurate measurement of results.

The development of farm crops and garden vegetables has been through far-sighted seedsmen, who have provided the groundwork upon which research has often built, and the co-operation which has carried the discoveries into farming practice. Again, a fairly large industry made of units of considerable size, and some very solid sums of money are concerned. Fruit, both tree and soft, and garden flowers also, have behind them considerable resources in widespread interest and industry. None of these branches have anything like the chance of mobilizing scientific teamwork on the scale of work on a new 'mycin', a deodorant, or a pump that is perhaps $\frac{1}{2}$ per cent more efficient than anything else on the market.

The chemist, physicist, or bacteriologist has the well-publicized dilemma that his work may be used for inhuman ends; the agricultural research worker has one far more familiar, the housewife's problem of spreading an insufficient sum over clamouring essentials. Despite the miracles of management performed by our research station directors, long-term work on an unpopular crop with a 'bad reputation' comes into the same category as linoleum for the back bedroom, with such problems as that of fundamental work on photosynthesis, on which all life and energy (other than wind, water, or atomic power) depend. We owe far more than we realize to the heritage of the past; as an example, to the absence of supertax and death duties in 1841, which not only allowed John Lawes and Joseph Gilbert to start Rothamsted Experimental Station, but to endow it. The money that pays for the balance is from Ministry grants, and the task of spreading these over the problems that cry out for solution, ranging from problems of veterinary research (with an industry in the background apart from the farmers) to those of systemic insecticides (with an even bigger one) is not easy.

All this is broad generalization, only broadly true, but with a fodder crop that can only bring profit to a few small nurserymen, and in which only a few men of greater enthusiasm than either wealth or technical knowledge are interested, the problem is at its most extreme.

We need a number of rather inefficient farms, inefficient because (among other things) all yields must be measured; its

staff including as many scientific as agricultural workers, and its buildings laboratories as well as dutch barns and piggeries. Unfortunately, we pay for this sort of farm very reluctantly through our Governments. One in Gambia and one on the Kongwa, established in the 1930's, could well have meant blazing economic success for the egg and the groundnut schemes, or saved vast waste and pointed the way to smaller but more climatically suitable achievements. Even when we have established one, the relatively small sums of its annual budget, while it is asking nature questions one at a time and waiting patiently for the answers, are at the mercy of 'economies' from successive Governments, or sudden and urgent needs that slice deeply into the small total allotted to agricultural research.

This reluctance limits the frontiers of Science just as progress, in the direction we are taking, has limited the frontiers of the World compared with the days of Joseph Busch. If the only questions Science can ask Nature are those which have a packet, a bottle, or a factory chimney in the answer, humanity is going to take the long way round world food shortage to synthetic meals with synthetic tastes, and miss easier and perhaps socially and economically more desirable developments of existing methods by crop improvements and better farming.

Carrying out in ten or more probably twenty years the work we have left undone on the Symphytums, the fastest-growing fodder crop for any temperate climate, will not be cheap or easy. It is expensive to prove anything on the land without a shadow of doubt, and the work comes under three separate heads.

The first is the obvious and simple job of testing out the possibilities on a range of soils, with a range of management and manurial treatments, of the strains of Comfrey which we have, and their feeding to all classes of stock. This includes the selective weed-killer problem, the even greater need for one which will kill the crop itself and allow rotational treatment more easily than by the use of pigs; also the economics of conservation, including hay, silage, drying by heat and cold blowing. It would mean running two mixed farms and two pig and two poultry farms, one of each to provide the 'control' of normal treatment for the particular soil and climate. These would be needed to discover the most profitable methods, in varied circumstances, of harnessing the growth speed of the plant to the British farming system. It might, as an example, be found that the grazing goose fed on wilted Comfrey, or the turkey, second only to the pig in food-to-meat conversion efficiency, could take a new place in

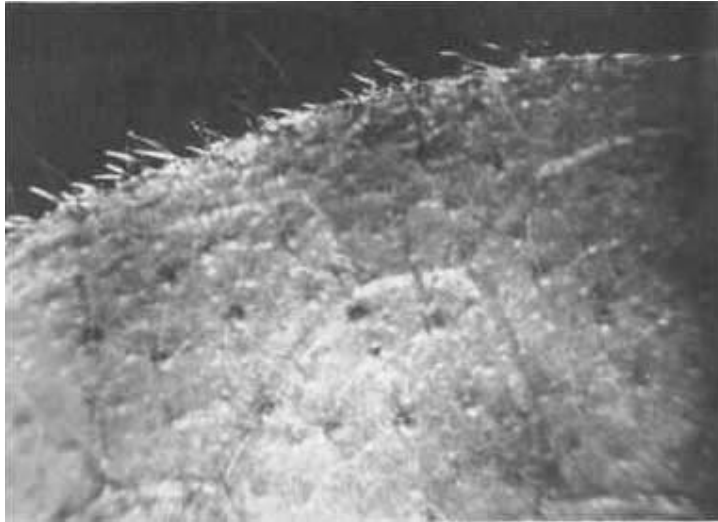
Britain's diet because of unknown saving in production costs from the new crop.

The 'disproving of claims' would have no place in the programme ; the evidence is overwhelming that our ancestors achieved the yields that we need to-day, but failed on utilization through lack of knowledge we now possess. The Kew Annual Report for 1879, on *Symphytum peregrinum*, closes most prematurely with the words: 'The knowledge of this plant and of its capabilities being now widely diffused, it will not be necessary to refer to it again.' We have to build on the basis of 1879, and find out exactly where we can go from the days of Henry Doubleday and Thomas Christy.

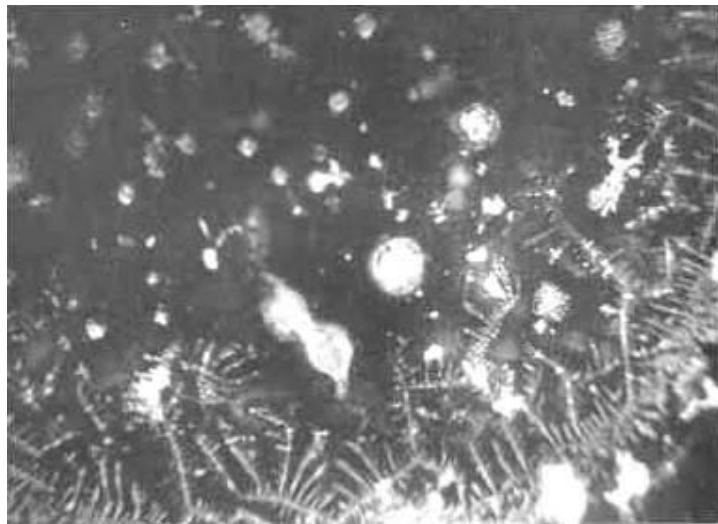
The second field is that of selection and breeding, which is almost entirely untouched. There are roughly twenty



18. Young Russian Comfrey grown indoors, photographed November 1952. Even with freedom from frost and light the plant went dormant through December and January. Early growth has been secured three weeks before the outdoor crop in a cold greenhouse as a 'health food' for valuable racehorse foals, and it is possible that turkey raisers would find it profitable to cloche a row or two for their first chicks. The plant is naturally deciduous and in sub-tropical climates dies down for two months of the year, usually in the dry season. The largest leaf provided material for plates 19 and 20.



19. Micro-photograph of a young Comfrey leaf. The 'pimples' are the bases of stiff bristles pointing towards the lens.



20. The swiftest river that flows uphill is the Comfrey sap stream; the oak pumps further but more slowly. These crystals from dried bristle fluid may provide a track where there is no highway in plant biology.

Symphytums and it is possible that *S. orientale*, with its softer hairs, would be among the desirable parents. Many artificial pollinations would be necessary, and in the three-year interval between seedling and cropping plants, plus the further interval for establishment, there would be constant handicaps. The number of seedlings destroyed after trial

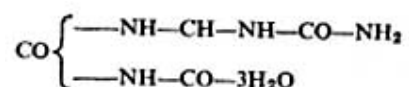
would run into hundreds of thousands, and the difficulty of destroying them completely would be a further problem until the killing substance was invented; one cannot employ pigs to rogue a crop, and constant forking would be the only answer.

The chief aim of the plant breeder would perhaps be (a) a seed setting variety with about the root life of a border lupin, roughly five years. This would remove the two main handicaps of persistence and high cost at one blow. (b) A winter-hardy variety which will stand frost at least as long as marrowstem kale (until Christmas) in all parts of Britain. (c) A hollow stem, thin-midrib, 'hay-strain' Comfrey. (d) An even heavier-yielding variety.

Finally, there is the laboratory and 'pure science' side of this unexplored territory. Immediately, there is veterinary research to discover how far the qualities of allantoin as an internal healer can help in the sphere of the diseases of livestock. There may be better and swifter remedies in the long-linked molecules of modern synthetics and the antibiotics and sulpha group of drugs, but feeding a profitable fodder crop which provides free precautionary medicine is good farm economy, even at the expense of the chemical manufacturer. This is of course why this question will never be asked out of taxation subsidies for industry; we must depend on the endowments of the past or the national foresight of the present for research that has fewer bottles and injection ampoules as its goal.

'Pure science' consists of asking one's questions like a small boy (or Newton's child gathering pebbles on the beach) for the sake of the answers alone, which can often light the way to discoveries of great importance in the most unlikely spheres. Comfrey is like a gipsy caravan passing the small boy in a country lane, it gives food for questions on a grand scale.

Why does Master Turner's specific remedy for the 'bursten' make



in such quantity in both leaves and stems?

These white crystals, which were remarked by the old herbalists shining on the dried roots 'of the shop' as a test of quality, and others, lower the freezing point of the sap solution very effectively for short periods of cold as in South Africa, where 15° of frost at night is very different from an English December. The suction of osmotic pressure increases with the difference between the total weights of the atoms that make up the molecules dissolved. Allantoin builds light

atoms into a heavy molecule, and in this and the still heavier potassium in such great quantity, may lie the key to the mystery of the swift river of its sap. It is possible that in this plant we have a simple model working on a quick coarse adjustment, like the heart of a crawfish in anatomy, or the *Drosophila* fruit fly in genetics, which will help us to understand the mysterious pump mechanism that makes every wood a forest of fountains through which water flows uphill.

The eighty-five-odd tons of water in a 100-ton an acre season's crop is but a fraction of the thousands of gallons that have been thrown into the air by transpiration—the 'empty packing cases' as it were of the mineral salts drawn up by the roots and distributed as tiny traces through every cell that needs them. The distance is relatively short, from the top of a three-foot plant to the lowest root-tip would be between ten and twelve feet, but the power to lift that water from the subsoil when the pastures lie parched and bare in a long drought, is exactly as much as would be needed to raise the same amount as far from a man-made well. The oak from tap-root to topmost twig pumps ten times as far but not so fast, and it is here that the most yawning chasms of ignorance cross knowledge that has stayed incomplete since the days of the steel engravings in well-known textbooks.

Anyone who has grown good Comfrey has had at least once a year the sudden shock of realizing the haste and violence of its growth; a long week-end, or a few days in bed with 'flu, and the sea of dark green leaves is hiding the land like a sweeping tide. Those great roots are forcing through solid clay, thrusting aside stones and packing the earth as they thicken and swell, and though there is a time in the early summer when all good farm crops rejoice in their strength, there is a thick-necked muscular fury about Comfrey that reminds one of the sort of bull who needs watching.

The energy of plants (and all life) depends on the absorption of sunlight by the living leaf; roughly 2 to 3 per cent of the solar energy that falls on every chlorophyll-containing surface is used to build up carbohydrates from the carbon-dioxide in the air and some of the water that pours out through the many-mouthed stomata, by splitting off the unwanted oxygen at the rate of 7 c.c. an hour for every 50 square centimetres of leaf area (roughly 3 square inches). By an unknown slow 'burning' process, oxygen is also taken up and the energy released as required from the sugars that stream as portable power wherever they are needed; perhaps by a tree-branch to overthrow a wall, or a potato forcing aside

the resisting earth as it swells from marble size to baking. In Comfrey, photosynthesis, as we call this basic power source of all life, and the energy of molecules darting in a solution which also comes from the sun as light and heat, is running at its greatest power. The plant has the quickest turnover of capital of all, to build cut after cut of leaves and stems, any one of which is a season's work for most crops. Much of this leaf-won food from sun and air is hoarded in the great roots, and gives the starting stock the energy that allows a first cut before the soil is warmed and kindly for surface-rooting grasses. These roots stay young all their lives, instead of hardening their arteries like those of a tree, with carbon locked up as cellulose, but we do not know which starches they use for storage. They may have a self-warming device like a dahlia tuber by changing one carbohydrate to another with heat release on a minute scale which winter ploughing disturbs, and here may lie a key to a killer perhaps effective for deep-rooted weeds also.

There are in the tropics many species that grow faster, especially the bamboo and the water hyacinth, but they have more solar energy out of which to take their 3 per cent and both swifter reactions and faster molecules from higher temperatures. The Russian Comfrey grows with semi-tropical speed in a cold climate, and therefore there must be something rather unusual about the chloroplasts in its cells and its metabolism in general. It is quite possibly several tenths of 1 per cent more efficient, the sort of saving that on a power station or a diesel engine would bring research expenditure on an almost military scale. We do not know the answers, and the secrets of this plant are hidden because we have never looked for them.

The high cost of accuracy and undoubtable proof may well leave this crop in the outer darkness for many years, with the mass of half-discovered applications of bacteriology, mycology and biology known as 'muck and mystery' (or more politely as 'Compost' or 'Organic Cultivation') from which good ideas seep quietly into farming practice and respectability, like Americans of negroid ancestry 'passing' as white. We know enough to justify the modern Henry Doubleday and the original-minded farmer or poultry-farmer growing this crop widely on a farm experimental scale, and it is to be hoped that in time he may educate the research scientists to the possibilities that have lain hidden for all these years. The basis handicap still remains—that uncontrolled and unrecorded experiments are rightly disbelieved by those who have the responsibility of other men's crops and stock. Some of the questions could be answered on a small scale by amateurs, but not in a hurry, not without records, and above

all not without the devotion to observed fact and absolute truth that mark every man who has made a worthwhile contribution to our knowledge of the land.

This book contains all that I know or can find out about this fodder crop, and an even larger book could be filled with what I do not know about Russian Comfrey, yet when one looks back on a hundred years' progress with the Leguminosae since their power of fixing atmospheric nitrogen with their nodule bacteria was discovered, it seems impossible that we shall not know vastly more in the next twenty years about utilizing the immense growth speeds of this neglected member of the Boraginaceae for the benefit of all mankind.

APPENDIX I

Botanical Descriptions and Genetics of the Comfrees

The following descriptions of the species of Comfrey mentioned in this book are reproduced from *Flora of the British Isles* by A. R. Clapham, T. G. Tutin, and E. F. Warburg (Cambridge University Press, 1952, 50s.) as a standard modern authority. Other descriptions can be found in works on wild flowers, but these are mainly restricted to our native species. A full account of the genus will also be found in the *Dictionary of Gardening*, published by the Royal Horticultural Society.

4. SYMPHYTUM L.

Hispid perennial herbs. Radical leaves petioled, cauline usually sessile or decurrent. Fls. in terminal forked scorpioidal cymes, nodding. Calyx campanulate or tubular, 5-toothed. Corolla funnel-shaped or sub-cylindrical, shortly and broadly 5-lobed. Scales 5, linear or subulate, ciliate, connivent, included, rarely exserted. Stamens included. Nutlets 4, ovoid, smooth or granulate, base annular, toothed, teeth clasping the receptacle.

About 25 spp. in Europe, Asia Minor, western Siberia and Persia.

1. Rhizome swollen and tuberous; roots fibrous; stems simple or with 1 or 2 short branches near the top; middle cauline leaves considerably larger than lower ones. 5.

tuberosum

Roots thick and tuberous; stems much branched; lower leaves largest.

2. Calyx-teeth at least as long as tube.

Calyx-teeth c. half length of tube.

4. *orientale*

3. Cauline leaves broadly decurrent forming a wing to the stem; calyx not accrescent.

1. *officinale*

Cauline leaves not or very shortly decurrent; calyx accrescent.

4. Upper leaves shortly petioled; calyx-teeth obtuse.

2. *asperum*

Upper leaves sessile; calyx-teeth acute.

3. *peregrinum*

1. *S. officinale* L. E.B.t. 1115-16; F. & S. t. 707. Comfrey

An erect hispid perennial, 30-120 cm. (1-4 ft.). Root thick, fleshy, fusiform, branched. Stem clothed with long deflexed conical hairs, branched, winged with decurrent leaf-bases. Leaves sparsely pilose, rarely with tuberculate bristles; the lower 15-25 cm., ovate-lanceolate, petioled; upper oblong-lanceolate, broadly decurrent at base. Calyx 7-8 mm., teeth lanceolate-subulate, twice as long as tube. Corolla 15-17 mm., whitish, yellowish-whitish, purplish or pink. Scales triangular-subulate, scarcely longer than the stamens. Nutlets shining, black. Fl. 5-6. $2n=c. 36, 48$. Hs. Still used in country districts as a poultice.

Native. In damp places, especially beside rivers and streams, more rarely in drier rough grassy places. 105, HI4, S. Generally distributed throughout Great Britain, though less common in the north and probably not native there; common but probably nowhere native in Ireland. C. Scandinavia to Spain and eastwards to western Siberia and Turkey.

2. *S. asperum* Lepech. 'Rough Comfrey'

S. asperrimum Donn (the name used in this book, and called 'Prickly Comfrey' in the period 1810-80).

A scabrid perennial up to c. 150 cm. (5 ft.). Root thick, branched. Stems much branched, covered with short, stout, hooked bristles. Leaves ovate or elliptic, scabrid or with tuberculate bristles; lower 15-19 cm., cordate or rounded at base, petioled; upper very shortly petioled, cuneate at base. Calyx 3-5 mm., accrescent, covered with short stout bristles; teeth linear-oblong, obtuse, becoming more or less triangular in fr., 1-2 times as long as tube. Corolla 9-14 mm., at first pink, becoming clear blue. Scales lanceolate, about equalling stamens. Nutlets granulate. Fl. 6-7. $2n=36$. Hs.

Introduced. Occasionally naturalized in waste places. Caucasus and Persia.

3. *S. peregrinum* Ledeb. B. & S. t. 256. 'Blue Comfrey'

(Henry Doubleday's 'Russian Comfrey'. The magenta-pink persists in many strains which are among the best fodder plants. Purple is also common, but not the dark purple of *S. officinale patens*.)

A hispid perennial, 100-200 cm. (3 ft. 4 ins. to 6 ft. 8 ins.) or more. Roots thick, fusiform, branched. Stems much branched, covered with long reflexed sometimes tuberculate bristles. Leaves softly hispid or with tuberculate bristles; lower 20-30 cm., elliptic-lanceolate or ovate-oblong, cordate,

rounded or narrowed at base, attenuate into a long petiole; upperovate-acuminate, narrowed at base, sessile, not or very shortly decurrent. Calyx 5-7 mm., pubescent or shortly and softly hispid, accrescent; teeth triangular-lanceolate, acuminate, twice as long as tube. Corolla 12-18 mm., pink becoming clear blue. Scales broadly triangular-subulate equalling or exceeding the stamens. Nutlets granulate. F. 16-8. $2n=36$. Hs.

Introduced. Naturalized by roadsides and at margins of woods, rather common. Perhaps not identical with the wild plant from the E. Caucasus, but with the hybrid *S.x. uplandicum* Nyman.

Hybrids with *S. officinale* are of frequent occurrence.

4. *S. orientate* L.

A softly pubescent perennial up to c. 70 cm. (2 ft. 4 ins.). Root fusiform, branched. Stems sparsely puberulent and pilose, branched. Leaves softly pubescent, ovate or oblong, subacute, petioled, petiole narrowly winged at top; upper subsessile. Calyx 7-9 mm., tubular, teeth c. $\frac{1}{2}$ length of tube, ovate or oblong, obtuse. Corolla 16-17 mm., white. Scales broad-subulate, slightly exceeding the stamens. Nutlets tuberculate, dark brown. Fl. 4-5.

Introduced. Naturalized in hedgebanks and grassy places, not uncommon in some districts. Turkey.

5. *S. tuberosum* L. E.B.t. 1117; F. & S. t. 708. 'Tuberous Comfrey'

A hispid perennial, 20-50 cm. (9 ins.-1 ft. 9 ins.). Root fibrous; rhizome stout, tuberous. Stems covered with reflexed bristles, simple or with one or two short branches near the top. Leaves puberulent and densely hispid; lower small, ovate or spatulate, narrowed at base, petioled; middle cauline 10-14 cm., considerably larger than the lowest, ovate-lanceolate or elliptic, shortly petioled; upper sessile. Calyx 7-8 mm., teeth lanceolate-acute, 3 times as long as tube. Corolla 12-16 mm., yellowish-white. Scales broadly triangular-subulate, acuminate, somewhat exceeding the stamens. Nutlets minutely tuberculate. Fl. 6-7. $2n=18$, c. 70.

Native. In damp woods and hedgebanks. 61. Scattered throughout Great Britain, local but commoner in the north; an escape from cultivation in Ireland. Germany to Spain and eastwards to S.W. Russia and Turkey.

Genetical Notes on Comfrey

(Prepared by Dr. P. J. Watson, Scottish Plant Breeding Station, Corstorphine.)

The Comfreys (the genus *Symphytum* belonging to the family Boraginaceae) are widely distributed over temperate Europe and the Mediterranean region, but only two of the sixteen species are indigenous in Great Britain. These are the Common Comfrey, *Symphytum officinale* L. and the Tuberous Comfrey, *S. tuberosum* L. Other species have been introduced and are now to be found in a semi-wild condition in various parts of the country, the most notable of these being *S. peregrinum* Ledeb. The latter, according to Bucknall (1912) frequently hybridizes with the most common British species, *S. officinale* L., and he has identified several crosses between these parents. The identification of hybrids is a matter of controversy, however, and it may be that a cytological examination of all available material would aid greatly in this matter. At present we have little knowledge on the subject and Strey (1931) is the only authority. He made extensive investigations into the chromosome numbers within the Boraginaceae and in his summary, he suggests that further research in the genus *Symphytum* will prove that the basic number is $x=9$. Maude (1939) in the Merton Catalogue takes $x=6$ but this certainly makes the degree of polyploidy very high in some cases. The Comfreys provide difficult material for cytological research as there is a strong tendency for the chromosomes to mass together within the cell, and thus make the task of counting quite impossible in some cases. Strey was, therefore, unable to give completely exact counts, but the following notes may be of some interest.

The most common count so far ascertained is that of $2n=36$ which if the basic number is taken as $x=9$, would mean that the majority of the species are tetraploids. One of our indigenous species, *S. officinale* L., is a tetraploid as is *S. asperum* Lepech. which is stated by Bucknall (1912) to be synonymous with *S. asperrimum* Donn. This has been verified in the Index Kewensis and it would seem that most British writers prefer to use the name *S. asperrimum* Donn. This plant may be found as an escape from cultivation in various parts of Great Britain, and this is the case also with *S. caucasicum* M.B. and *S. uplandicum* Nym, both of which Strey found to be tetraploids. Strey states unhesitatingly that the behaviour of the chromosomes during meiosis indicates that *S. uplandicum* Nym is a hybrid and mentions that it had already been identified as such by various writers. The older writers, Lindman (1911) and Schinz and Thellung (1912) think it is a hybrid between *S. asperum* Lepech, and *S.*

officinale L., whilst Bucknall is said to assert that it is a cross between *S. peregrinum* Ledeb. and *S. officinale* L. In actual fact, he does not mention *S. uplandicum* Nym save to identify it with *S. peregrinum* Ledeb. itself. It is sufficient here, however, to say that *S. uplandicum* Nym is undoubtedly a hybrid.

The remaining two plants mentioned by Strey are both octoploid according to his theory. They are *S. tuberosum* and *S. bulbosum* Schimp, and both species are smaller and more delicate than the tetraploid species. It would seem that polyploidy has changed the habit of growth of these species as both have developed storage root systems apparently at the expense of the upper portion of the plant.

The Comfrees are interesting on account of their possible utilization for cattle fodder, and it is worthy of note that *S. officinale* L. has frequently been used in that capacity. *S. asperum* Lepech. has also been used as a fodder plant and Strey mentions that the gardener from whom he obtained plants of *S. uplandicum* Nym was in the habit of using it as food for his pigs. *S. peregrinum* Ledeb. is frequently found in this country as an escape, for at one time it was regularly planted for cattle fodder. It may be interesting to add that Bucknall mentions that *S. peregrinum* Ledeb. produces seed abundantly in this country, whereas *S. officinale* L. is often quite sterile. (This is not the experience of the writer of this book or any modern Comfrey grower.)

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TRANSLATED EXTRACT FROM
Karyologische Studien an Borraginoideae
By
MARTIN STREY

Material and Methods

Buds

The fixation time varied according to the time of year and the weather. Fixing fluid for the buds was Carnoy. All for 5 to 20 hours.

60 parts alcohol (absolute or 96 per cent)

20 parts acetic alcohol

20 parts chloroform

First giving a shock with cold water was not successful (in spreading chromosomes).

Sections were cut at 10 or where the buds were very small 8-9. Two hours each in mordant and stain—if given more—the cytoplasm became stained (iron-alum haematoxylin Heidenhain) was used with a differentiation of 7-10 minutes.

Root Tips

Seed obtained from many parts was sown but not all the seeds were capable of germination. (Brand 1921 says only 30 per cent of seeds of certain Boraginaceae are capable of germination.) Root tips first fixed in Navashin

10 ml. 1 per cent chromoic acid

4 ml. 40 per cent formalin

1 ml. acetic acid

but this rendered the root tips 'stemhart' and the ribbon was torn when cutting was tried. Those which survived showed indistinct structure.

It was found that middle Flemming was a better fixative (Bonner's mixture) and using chloroform instead of xylol. With this fixture, the cytoplasm took on a greenish-grey colour.

Mordant and stain for two hours and a differentiation of 8-9 minutes.

Symphytum

S. officinale L. A great tendency for the chromosomes to be 'clumped' together and a preliminary shock of cold water was without effect. A *possible* count of 18 was obtained in the buds, 36 in the root tips.

S. uplandicum Nym. The cytological picture is once again uncertain. There are some chromosomes which move more quickly to the poles than the rest. There is a looser arrangement of the chromosomes than in the above, but still the tendency to lumping is great. On the grounds of the indentations of the lumps, 18 were counted in the buds. *S. uplandicum* is thought to be a hybrid between *S. asperum*

and *S. officinale* (both are used as feed plants as is the hybrid for pigs).

S. asperum. It is just over 3 ft. high with strong bristle-like hairs pointing downwards. The foliage leaves are more or less heart-shaped narrowing at the base but not decurrent. *S. uplandicum* is smaller and not so rough. The smaller foliage leaves are decurrent above, below they are pointed and slightly decurrent. The corolla is -34 times as long as the calyx. Some identify this hybrid with *S. peregrinum* Ledeb.

S. caucasicum M.B. This shows unreliability in counts and much lumping as *S. uplandicum*. Number seems to be about 18.

S. bulbosum Schimp. and *S. tuberosum* L. The count appears in both to be about 72, but again they lie on top of one another etc. Phenotypically both are smaller and more delicate than those kinds with a haploid number of 18. In *S. bulbosum* the division is regular, the chromosome plates lying lengthwise in the root.

Summary

Not possible to give an accurate number. The examinations point to $n=18$ and multiples of that number. It may be that the haploid number is 9 as in *Cerinth*. It might be shown how the haploid number 18 originated—that it was not by steps from $n=14$ but as tetraploid from $n=9$. It can be taken that these forms which show increase or decrease from the basic number are the younger, so the *Symphytum*, *Pulmonaria*, *Alkanna* are young and of course the polyploid forms within these species.

| | <i>Haploid</i> | <i>Diploid</i> |
|----------------------|----------------|----------------|
| <i>S. officinale</i> | c. 18 | c. 36 |
| <i>S. asperum</i> | | c. 36 |
| <i>S. uplandicum</i> | c. 18 | |
| <i>S. caucasicum</i> | c. 18 | |
| <i>S. tuberosum</i> | | 72 ? |
| <i>S. bulbosum</i> | | 72 ? |

APPENDIX II

The Veterinary Uses of Comfrey

(From *Herbal Handbook for Farm and Stable* by Juliette de Bairacli Levy. Faber & Faber, 18s.)

S *ymphytum officinale* Linn. Popular names: Common Comfrey, Knitbone, Knitback, Great Consound (Elizabethan), Yallune (Saxon), Blackwort, Bruisewort, Slippery Root, Boneset, Gum Plant, Consolida, Ass Ear. (The properties of both *S. asperrimum* and *S. peregrinum* are medically the same.)

'Use. Cure of all internal haemorrhages, including uterine. To aid the reunion of wounds and the knitting of broken bones. Treatment of internal ulcers, also ruptures. The mucilaginous content of the leaves makes the herb valued as a remedy for pulmonary ailments. Externally the leaves make an important poultice for all types of swellings and fistules.

'Dose. A good drench is made from 1 lb. of comfrey boiled slowly in 1½ qts. of water for an hour. When boiled a handful of ground ivy should be added, and 2 oz. of Spanish liquorice; brew well. A half-pint drench should be given three times daily. For treatment of internal ulcers molasses should be added, one dessertspoonful per half-pint, and the drench given with an equal part of raw skimmed milk. For bone knitting feed two handfuls of well-bruised roots daily. The foliage also possesses powerful knitting properties. For poultices take a good handful of leaves cut finely mixed with bran, place upon a square of flannel, fold, boil in water for five minutes, wring well and apply hot'

In the many herbal accounts the mucilage is greatly stressed, because herbalists as a rule quote to-day what was new knowledge seventy to a hundred years ago. The efficiency of the green fodder as a cure for scour is based not on herbalists but pigmen and stockmen. Their traditional method is to dig up as much as they can find of the roots and leaves and give the animal all it will clear up for two days, which cures the trouble.

The value of allantoin as a preventative medicinal by-product from a green fodder has never been investigated, and though 'scour' is a term that covers many forms of digestive trouble, it is likely that it is effective for some of the internal

disorders of some stock. Experiments in preventative medicine are the least likely to be carried out and the hardest to perform with accuracy, but by far the most valuable. There is an urgent need to lift the knowledge of this plant out of the hands of the herbalist, and the category of a medical curiosity.

Though an ash analysis is given in *Die Pflanzenstoffe* by C. Wehmer, and one by Tithirley and Coppin is quoted in the article in the *Pharmaceutical Journal* mentioned below, no allantoin is revealed in it. An analysis of ash made by agricultural or other laboratory methods that involve burning the dried Comfrey cannot show the form in which any substance exists in the plant as eaten by stock. From the formula on page 141 or in any textbook of organic chemistry it will be seen that carbon, nitrogen, hydrogen and oxygen, however linked, cannot be detected by the rough-and-ready methods.

The best account of the Symphytums and allantoin, apart from those in the text, will be found in the article in the *Pharmaceutical Journal*, 27th January 1912 by R. J. Harvey Gibson, M.A., entitled 'Notes on the Ancestry and Herbal History of *Symphytum officinale*'. Other accounts will be found in an article in *The British Medical Journal* for 16th January 1912, by J. Macalister, and in the *Chemist and Druggist*, 13th August 1921.

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APPENDIX III

Moisture Content of Green Crops

The determination of the moisture content of a sample of green crop material requires apparatus for weighing which must be rather delicate for ordinary farm work, and there is no convenient device for finding this rapidly in the field. Considerable time is required to make the measurement when the sample is taken indoors.

The shredded, weighed sample must be dried completely without burning the dry matter, which may be a very small amount, and must be weighed very carefully to avoid serious error; or, the actual water present in the weighed sample may be collected and measured by distilling it in carbon-tetra-chloride. The latter is definitely a laboratory undertaking and is preferred for official analyses.

With vegetation, the total weight of any sample consists of an unknown weight of dry matter, W , together with a weight of water, w , and is $(W+w)$. The percentage moisture content is:

$$\frac{w \times 100}{(W + w)}$$

During the drying process, only the weight of water changes, so that if we weigh a sample and evaporate say 4 units of water from the bulk without drying it completely, the new moisture content is:

$$\frac{(w-4) \times 100}{W+(w-4)} \text{ per cent}$$

this does not help to establish the relation between W and w .

All the water must be removed before we can find W .

The general behaviour of a drying substance can be shown graphically by considering a sample large enough to contain one unit of dry matter, so that $W = 1$. The weight may be expressed in pounds, grams or tons, provided that we keep to the same units and there is no chemical change in the dry matter.

When $W=1$, the percentage moisture content can be calculated when $w = \frac{1}{2}, 1, 2, 3 \dots$ to any value, and the graph of these figures, up to 90 per cent, is reproduced in Table 4.

This graph would continue indefinitely to reach 100 per cent, and there would be 19 lb. of water to 1 lb. dry matter at 95 per cent.

It will be seen immediately that there will be 3 tons of water for each ton of dry matter at 75 per cent, 4 tons at 80 per cent and 5½ tons at 85 per cent.

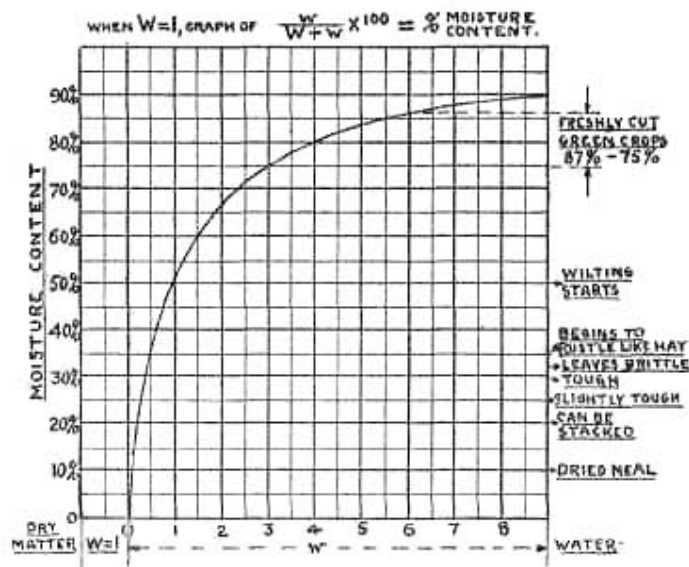


TABLE 4
The drying curve of grass and fodder crops

Thus 6½ tons of green crop ($W+w$) will be required to produce 1 ton of dry matter at 85 per cent m.c.

In the field the farmer is compelled to rely on the small changes that occur to judge the condition of his wilting crop. The determination of the moisture content from samples taken at such points, could be helpful.

For making hay, the stages of drying give an approximate indication of the moisture content and Mr. Cameron Brown and Mr. Finn-Kelcey give the following guide in their Technical Report W/T 17, on Barn Hay Drying, which may serve as an indication of the type of information required for wilting or drying other crops.

| Condition of Material | Moisture content Per cent |
|---|------------------------------|
| Freshly-cut grass | 75-85 |
| Starting to wilt | 50 |
| Rather heavy to handle | 45 |
| Begins to handle like hay and rustles | 35 |
| Leaves getting brittle but not shattering | 32½ |
| Tough | 30 |
| Slightly tough | 25 |
| Dry enough to stack | 20 |

A small balance of the type used for educational purposes with a box of weights 50 gm. to .001 gm. will be much cheaper than a special moisture tester, it will be just as convenient and have other uses.

The small boxes supplied with typewriter ribbons are very useful for taking samples in the field. These can be stored for a day or two without loss of moisture.

The sample material is cut into shreds with a sharp knife or pair of scissors, and 10 grams of this material can be weighed out. The sample is then dried in a warm place until it ceases to lose weight to obtain the dry matter W. This weight, subtracted from 10, gives the weight of water, w. It is then only necessary to move the decimal point one place to the right to obtain the moisture content.

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The following list of references is far from complete; its aim is to give a representative picture of the available literature of the Symphytums. So many of the accounts repeat each other, many more quote each other, and at every stage the same confusions and errors occur, the same successes are reported and the same problems arise. Four close-packed columns cover *Symphytum asperrimum* and *S. peregrinum* in the bulky catalogue available in the Lindley Library (R.H.S. Vincent Square, Westminster, S.W.1), but many of these are botanical descriptions only. The quantity of letters to the press is almost inexhaustible. The *Farmer and Stock-Breeder*, first published 1843, *The Field*, first published 1853 and the now defunct *Country Gentleman's Magazine* are the best hunting grounds. The *Gardeners' Chronicle* references in the following list cover a very fair sample of what could be found. Almost any farming or country periodical and any farming work dealing with forage crops published between 1840 and 1900 will have some reference to Comfrey, and so will the journal or transactions of most agricultural societies.

All this mass of print can tell us is that some of our ancestors grew Comfrey well, and some grew it badly, some liked it and some did not, they were as confused among the species and hybrids as we are, they were handicapped by lack of the knowledge we now possess, and aided by an unprejudiced appetite for personal experiment which we have lost in an expert-dominated age. It is unlikely that research in libraries will reveal anything of real value to the future of the Symphytums, compared with even garden-scale experiments in nutrition, yields, manurial treatment or any of the paths described in this book that lead straight to unknown country.

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- 1915 'Der Anbau von Beinweh', Artur Mahner, in Number 9
of *Land und Forstw. Mitteilungen*.

The leading German agricultural periodical, *Deutsche Landwirtschaftliche Presse* has published many articles on 'Beinwelp' (Comfrey); one in vol. 35, 1908, by Professor Dr. Werner of Bonn-Poppelsdorf traces the history from 'den Engländer Grant' and gave a rather bad account of *S. asperrimum*, and was replied to by a Dr. Weber in the next issue, who had from his figures and description, got Henry Doubleday's *S. peregrinum*. Letters appeared from time to time, including one in vol. 59, 1932, page 20, recommending 3-5 kilos a day as an extra fodder for pigs. In general, opinion of the plant is unfavourable, except for Dr. Weber. No modern work has been done, and knowledge of the crop is if anything less than in Britain. Some accounts appeared in France in the 1870's from Thomas Christy's exports but the plant has been under all its British handicaps, with one extra; the peasants on the Continent who grew it never wrote to the papers.