The Mushroom Journal

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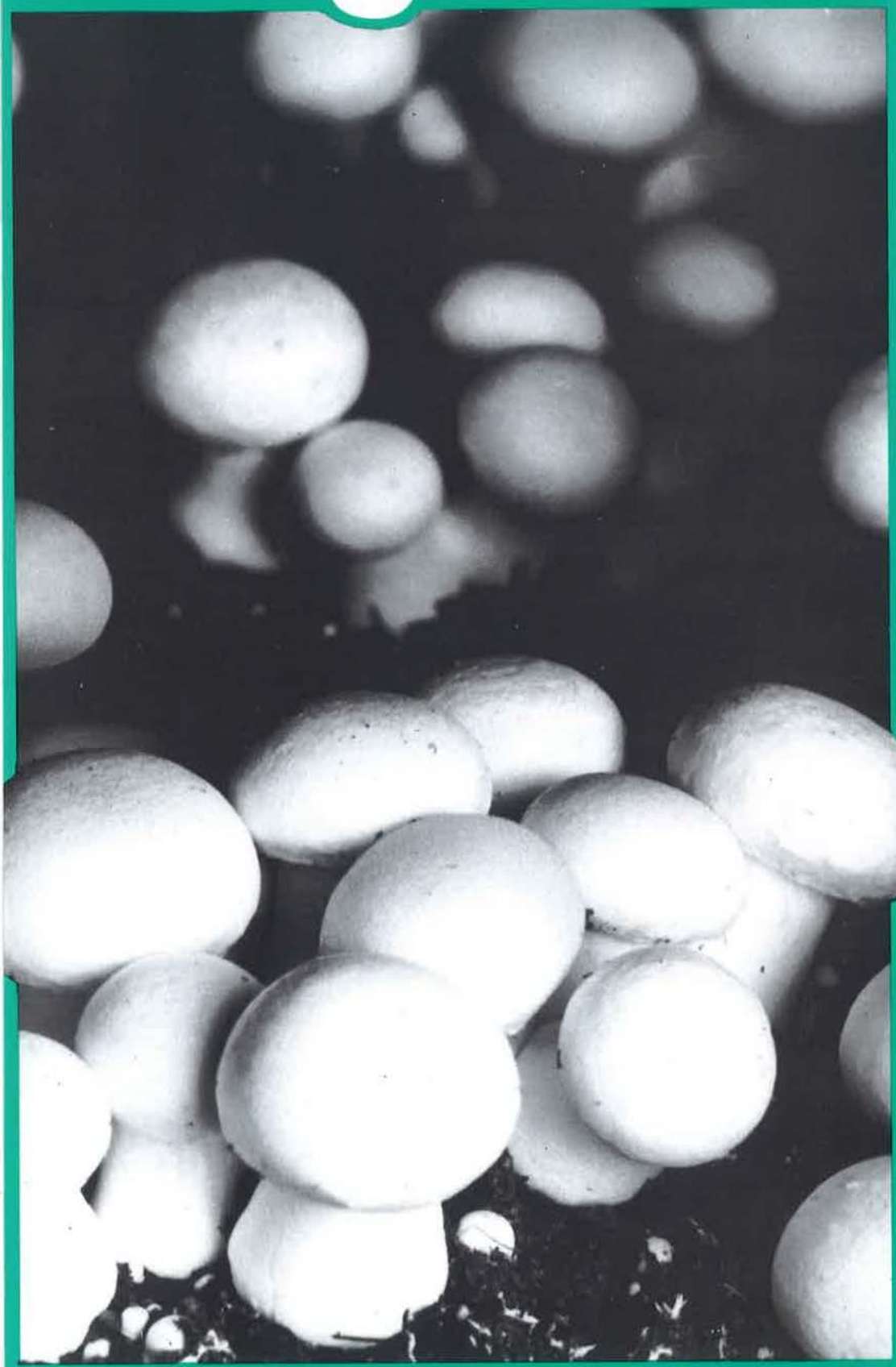

CONTENTS

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Director's Notes

Ken James

Journal No. 200

In terms of trade magazines, the 200'th issue of the *Mushroom Journal* may not appear to be a very significant landmark. BUT - the decision which resulted in issue number one being printed in January 1973, was a very far sighted one. It gave the whole industry, worldwide, a focus for communication. So the *Journal* is now read by the mushroom industry, in 62 countries.

I believe that we should be grateful to those responsible for giving the industry a worldwide mouthpiece. According to John Bleazard, who was vice chairman at the time, the bulk of the work was inevitably done by our old friend Winston Alderton, first editor and secretary of the Association. Chairman, George Powl, tragically killed in late 1972, and John Bleazard, together with the Executive, added the technical input.

For their sakes, we must always make full use of its pages. A tribute from Baroness Trumpington in this issue, is very much appreciated.

8th North American Conference

It is appropriate that I pay tribute to the authors of the *Journal*, on the day I have returned from the 8th North American Conference in Calgary. That event too, is a meeting place - for scientific, technical and grower minds, who make up the industry worldwide. Over 400 delegates from nearly 20 countries, provided a significant cross section of the industry. Discussions ranged across heavy metals, quality, the environment, promotion and market structures.

The need for growers to make better use of the scientific knowledge scattered around the world, led to a suggestion that small scientific groups; with specific agendas, should be sponsored by associations. The first, dealing with compost could be in Australia in 1990. It could fit in well with the MGA conference theme for 1990, which I hope will deal with mushrooms and the environment. With the next N American conference set for San Antonio in February 1991, the MGA conference in Bournemouth at the end of August 1990, could well become a transatlantic one; concern for the environment crosses more than just the Atlantic!

There has long been a recognition of mushrooms as a worldwide industry. The 8th North American conference, adds impetus to the need for us to recognise that people make up our industry - and in all sectors we must collaborate to make best use of widely dispersed but often superb, human resources.

Thanks to Pat Lord, President of the Canadian MGA, Hank Taylor, his trusty driver (See photographs p 240), but really executive secretary, plus a conference committee, led jointly by Boris Bodnarchuk and Ralph Hazelwood, - who made us think big, in an industry where attention to detail is of utmost importance.

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A message from the Baroness Trumpington on the 200th issue of Mushroom Journal

I was delighted to be asked to contribute o this 200th edition of the Mushroom ournal. I have always enjoyed eating nushrooms whether by themselves or vhen they are used to spice up other lishes, and being a keen cook I like to :xperiment. Mushrooms are always deli-:ious - cooked or raw!

First, I should like to congratulate the Mushroom Growers' Association on the vork they have done over the years in)romoting mushroom growers' interests. particularly commend them for their maginative and amusing campaigns to nake us aware of how tasty and versatile nushrooms are. Their "Make room for he mushrooms" slogan launched in .983, led to a doubling of mushroom :onsumption by 1987, a success by any tandards. I hope their latest campaign urging us to "Make your meals mushroom" will be as successful. I understand that it has already got off to a good start and I wish it every success.

I know that the industry has not been without its share of problems. Mushroom growers have no intervention arrangements to fall back on and must look to the market for their returns. And they are having to face increasing competition from other Community growers, particularly the Irish and Dutch. But I am confident that our growers can hold their own. I was especially interested to learn of the move, launched at the recent International Fresh Produce Fair, to put potential customers in touch with local mushroom growers so as to ensure the freshest possible supply. This shows a positive approach to selling which must give them an edge over their competitors. I also welcome mushroom growers recognition of the importance of R & D and their wish to fund some of their own near market projects. Such research is clearly essential if the industry is to keep ahead of its competitors.

The industry has come a long way since the first Mushroom Journal was issued in January 1973, more than doubling its annual production for which it has established an increasing demand. But then it has an excellent product, highly nutritious, easy to prepare and good value for money.

My warmest wishes go to the MGA and its members for the next 200 issues and beyond. Long may your industry continue to mushroom!

CONFERENCE '89
VIKING HOTEL, YORK
27 - 29 SEPTEMBER

As the conference hotel is now fully booked, we have arranged block bookings at two overflow hotels close by. Please mention the MGA when booking at either of the following: Crest Hotel, 1 Tower Street, York, WO1 1SB, Tel: 0904 648111, or, Novotel, Fulford Road, Fishergate, York YO1 4AD, Tel: 0904 611660.

The speakers programme has now been confirmed. Photos and lecture details appear below...

THURSDAY 28TH

Ben Wragg, International Consultant
Laurence Gould Consultants Ltd
'Changing Patterns in Supply and Demand'

Tony Davey, Senior Training Advisor
National Institute of Fresh Produce
'Improved Efficiency through Staff Development'

Dr David Wood, Scientist
ADAS
'Mushroom Enzymes - Past, Present and Future'

Dr Tim Elliott, Scientist
Institute of Horticultural Research
'Sinden Award Lecture'

FRIDAY 29TH

Aoife O' Brien, Sales & Marketing Manager
Darmycel UK Ltd
'Practical Aspects of Virus Control'

David Stephens, Sales & Marketing Manager
Vokes Limited
'Filter Selection and Applications'

Geoff Robins, Managing Director
HPS Control Systems Ltd
'The Latest Developments in Environmental Control'

Ron Jones, Grower
Pixie House Mushrooms
'A Confrontation with High Technology ..... or, The Search for True Happiness!'

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A photographic record of th

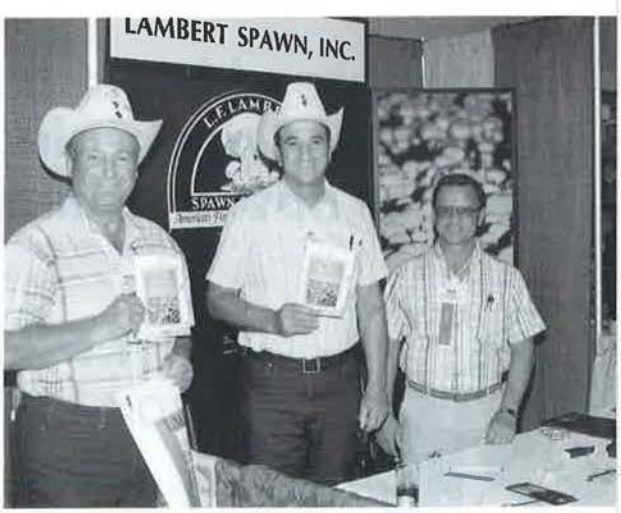
The opening conference session, with Peter Baker (MGA Chairman), Dr JPG Gerrits, (Horst) Dr Noel Arnold (Aust) and Chairman Ernie Skrow (Ontario).

Most of the UK delegates were in serious mood at the conferen Mary Sikorski, Colin Bell, Jacques Le Pere, Tony Green, Tc Russell & Aoife O' Brien with Chris Bagshaw & Jim Dumbre behind.

'Real Cowboys' at the Round Up. Gil Edge, Bob Dumbreck and Ferd Hensby.

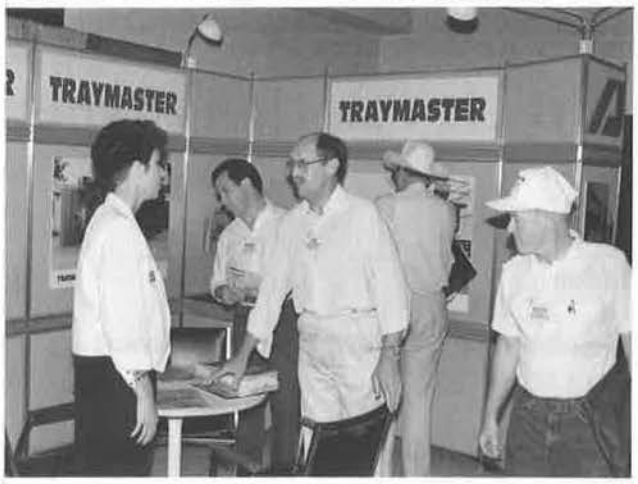
N. American presidents Pat Lord Canada & Jamie Ciarrocchi, U arrive by pony sledge, with 'driver' Hank Taylor (CMGA Ex Sec.) & his wife, Joyce.

In enthusiastic mood at the pre conference 'Round Up' Jan Pijnenborg & Pat Lord (President CMGA)



Our pub grub recipe leaflet was popular at all events.

3th North American Conference



busy time for Tony Russell at the Trade Exhibition'.

Aoife O' Brien at home with the N. Irish contingent Eugene Fox (Chairman of the UFU Mushroom Comm.) Patrick Daly, Tommy Daly, Martin and Malachy Kernan.

ome 'Yee-haa' cowboys and gals take some time out for a roup shot! Top left: Dan Braniff, Aoife O' Brien, Sharon rook, Lee Russell, Tony Russell and Colin Bell.

Part of the UK party at the banquet with Sylvia and Ferd Hensby, Ruth & Gil Edge with Margaret James.

m & Maggie Dumbreck celebrate their wedding nniversary on the banquet night, director Ken mes makes the presentation.

A more detailed review of the Conference will appear in a future issue.

Bob Dumbreck & Chris Bagshaw discuss a technical point whilst Mrs Chris Dumbreck enjoys the limelight!

Some recent developments in the cultivation of the *agaricus* mushroom and their relation to the industry.

by **James W. Sinden**

Delivered at the Conference on 'Ecology & New Techniques of Composting Indoor Compost' held in Verona, 20 May 1989 & re-printed by permission of the A.I.F.

This paper will not introduce you to any new methods or techniques offering big gains in production, profits or economies. What I shall try to do is to survey the present state of the art of mushroom growing, to evaluate some of the innovations of the past few years and to give my view as to their relative importance under the varying conditions of mushroom growing in several countries.

As we all know there has been a remarkable and sustained increase in consumption of mushrooms since 1950. Partly this increase is a result of the broadened diet of urbanized population to include more kinds of food. Partly it is because the price of mushrooms has lowered relative to that of other competitive foods. The newer ways of growing mushrooms have made this lower pricing possible. Less labour, more efficient use of the composting materials, higher yields, better varieties and better use of the costly, climatized space necessary for mushroom production are some of the reasons reduced costs have been possible. Mushrooms are no longer a luxury item.

In the past there has usually been just one way of growing mushrooms in a country or area. For instance in France all mushrooms were grown on ridge beds in abandoned underground quarries for several centuries. In the chief mushroom growing area of the USA, Chester County, Pennsylvania, all were grown on shelf beds in so-called standard double mushroom houses for at least 50 years. Today there are five or six rather different systems all of which can compete successfully although variations in regional requirements may make one system dominant under special conditions. Such conditions include labour availability, climate, materials and maybe governmental promotion.

Successful growers appear to depend more on the business and managerial abilities of the owners or their delegates than on the system they use. In other words, any system can be successful if used properly. Failure is most likely when adaptability is not shown to selection of those innovations suitable to his situation and rejection of the rest. Also meeting the demands of the market for his product in its various forms is essential. Too many growers try to force their mushrooms onto unwilling markets in an unsatisfactory condition or package.

Let us first list five systems of growing currently used by growers in the order of their development and try to place them in relation to their suitability to the varying conditions of the industry.

The oldest system is the ridge beds of the French where cultivation of *Agaricus* mushrooms originated to the point that it is still known as champignon de Paris all over Europe. These were particularly adapted to the small, narrow, crooked tunnels of the quarries and the fact that no machines were available or even usable for handling the compost. Other similar underground areas also used ridge beds in Belgium, Switzerland, Austria and Hungary. Today these have been mostly, though not all, converted to one of the other systems.

The next system, started in England, crossed the Atlantic to Eastern Pennsylvania in the USA to become the shelf beds of the so-called double mushroom houses, each holding about 800 sq. m of bed area on racks of shelves six beds high. For fifty years or more this system dominated American mushroom growing almost 100% and was so successful that the USA became the second largest producer in the world after France. Simple but effective methods of handling the compost and casing, still manually, but with some mechanical help kept the costs low especially because of the low wages paid the immigrant workers mostly from Italy for the first thirty years. When the Italian immigrants became the dominant owners of the Chester country mushroom farms their labour became groups of black workers who filled, emptied and cased the houses on contract. The rest of the labourers are Spanish American, especially pickers. Many of these farms with their rows of double houses are still operating although their ownership has been consolidated into larger units and many smaller growers have left the industry. They have been slow to adopt the innovations prevailing elsewhere. Similar shelf bed farms were established in Italy and England especially.

The third system was on trays. It was originated in 1934 by Knaust brothers at Coxsackie, New York along the Hudson River 200 km. north of New York city. Use of the tray system grew rapidly especially after the war when farms producing millions of kg per year were built near the big cities of America. The tray system requires, as we know, heavy and expensive machines for handling at all stages. While it is adapted to mechanization more than any other, the cost of this equipment made the system prohibitively expensive for small farms. Most of the large farms in America eventually used trays. They necessitated more skill to use the machines although Spanish Americans are still the dominant labour force. The establishment of the tray system and its industrialization attracted the attention of some big publicly-owned food corporations. They entered the business

enthusiastically but all but one were disillusioned when the vagaries of the market resulted in less profitability than expected. They have now given up, leaving behind them large growing operations now in the hands of their managers or other individual owners. Mushrooms produced by these farms are still a big factor in the American market, although others have gone out of business. Among the casualties was Knaust brothers who failed to adopt the labour efficient machinery necessary to make the system viable.

The tray system went to Europe in a very big way and was soon the predominating way of growing mushrooms in most countries. Even in France trays replaced ridge beds wherever access to the underground quarries made machine transport possible. There, especially at the Hauser farm in Switzerland, mechanical handling was improved to the point that American growers travelled to Europe to see how to grow mushrooms efficiently. It was a time of rapid expansion in demand for mushrooms and many new farms were built, nearly all using trays. England, Germany and Scandinavia all adopted the tray system.

When the Dutch developed their mechanization of shelf beds the situation, looking stabilized on trays, changed dramatically. The Dutch government in order to resettle oystermen displaced by turning a shallow sea into farm land encouraged them to go into mushroom growing in eastern Holland. Shelf-bed farms of very small size together with residences were built for them under very generous terms and the methods of growing mushrooms were taught them by government paid experts. More than a thousand of these small farms were soon established but despite the supervision of the authorities many of the growers were soon in financial difficulties and gave up in despair. To rescue the budding industry intense research and development was undertaken and the Dutch system, as it in now known, was the result.

First a central composting centre was established to furnish all of the growers with their compost, followed quickly by mechanical equipment for filling and emptying the shelves. More and more sophistication of the system has ensued thanks to cooperation between mechanical engineering firms and the most highly developed research station for mushroom culture in the world. Today the Dutch mushroom growing system is the most highly mechanized of all and is esteemed throughout the industry as the prime system in efficiency of labour, materials, and energy use. It is, however, especially adapted to relatively small farms and bigger ones built to the demanding specifications required have not always been successful.

The last system to be developed is known as the bag or block system. The compost, after total preparation and spawning, is filled into plastic containers, bags or rectangular blocks, and transported to the growing areas where they are manually set in the place on the floor or on shelves in rather simple structures or in underground tunnels where machine transport is not feasible. This system is increasing in use under rather special circumstances. Usually a compost centre prepares the containers and disperses them to the growers consisting of householders who have built half-round plastic huts or have unused out-houses on their properties. Rarely are these units big enough to hire helpers. In English this is called a cottage industry. While not a big factor in most markets, the mushrooms from them are not to be dismissed as inconsequential. Ireland and Spain produce sizable quantities mostly for export into areas where labour is more expensive or the currency value is higher.

Now I shall devote the rest of my talk to a discussion of some of the innovations related to preparation of compost and the beds before production of the crop. Many of these have led to very important changes in our ways of growing and to the economy of the industry.

During my talk I shall refer, perhaps too often, to my observations of the course of events at the biggest tray system farm in the world, now known as Moonlight Mushrooms. I have been a consultant for this firm since its beginning in 1937 and for some years before that with the owners, the Yoder brothers, at Barberton, Ohio, who grew mushrooms by the standard shelf bed system for some years until they moved their operation into an abandoned limestone mine in Western Pennsylvania. None of the 1000 employees is Spanish American.

Today, in one mine comprising nearly 200 km of tunnels 10 to 12 m wide and 4 - 4 m high, this firm grows 20 million kg. (20,000 tons of mushrooms annually) mostly for the fresh market. Less than ten percent is rejected from the first quality, solid, tight, cut mushrooms demanded by the American market. Currently the yield is 25 kg per sq. m at 0.75 kg per kg dry wt of compost. They pick three breaks and have a cycle between casing and emptying of only 29 days. Such efficiency could never have been achieved without their adopting some of the innovations we will discuss.

From my viewpoint of 59 years associated with mushroom growing, the preparation of the compost has undergone the most changes and development of any part of the whole business. Even now it is the least standardized operation and may change significantly in the coming years. Perhaps my greatest interest is in composting because I was hired as a research professor at the Pennsylvania state university with the prime mandate to develop a substitute for the fast dwindling supply of horse manure supplying the 350 mushroom growers in Chester county with the material on which their livelihood depended. In those far-off days, one ton of manure bought would fill seven square meters of bed and produce on average 35 kg of mushrooms or 5 kg per sq. m. during four to eight months of harvesting they were composting the manure in piles 8 to 12 m wide turned by hand for up to 40 days.

As we know, the preparation of the compost is now divided into two principal phases, the first at high temperatures of 65 - 80°C and the second at a much lower temperature of 45 - 55°C. Until recently the first phase has always been done in the open air whether under cover of a roof or not. It is the first phase which today is most diverse and is still undergoing changes and modifications.

The reasons for the present special attention to phase 1 are the materials available, the space and time required and especially the impact on the environment.

The raw material is no longer principally straw-bedded horse manure although where that can be obtained it is usually preferred. When not, many substitutes can be used. Wheat straw is most common although rye, oat and rice straws may be substituted. In the Eastern United states, hays of various sorts are preferred to straw together with additions of maize cobs, cotton seed hulls and shredded bark from deciduous trees, not conifers. The main source of nitrogen, as being the

cheaper, is chicken manure but inorganic nitrogen fertilizer and protein-rich seed meals can be and are used. No single formula has to be followed but the final compost should have 2 to 2.5% nitrogen in an organic form and have a large amount of fibrous carbon present.

Many growers and even investigators do not realize the full part played by phase 1 composting in making compost capable of supporting a big crop of mushrooms. What phase 1 does and must do is to provide nutrient more or less exclusively available to the mushroom and not to other fungi. Although the literature is full of talk about this as a humification process, this term is misleading. Humification is a long-term, slow process occurring under usually cold, wet conditions like bogs and swamps under water thus excluding air. The result is peat which, when pressed between rock strata becomes eventually coal. Since it is dark brown to black, as is our compost, the mistaken impression is that the two processes are the same.

Our composting process follows a different path and ends with different dark coloured compounds, not the humic and fumaric acids prevalent in peat. We follow the path leading to charcoal, where wood in the presence of small amounts of oxygen loses water bound with carbon as carbohydrate, until it is pure black carbon. During the course of the water loss, the compounds go through a gradual darkening known as caramelization. This process can go on slowly or fast depending on the temperature and also surprisingly, on the presence of ammonia. The commercial process of producing the caramel colouring used in many food products depends of subjecting sugar to this combination of heat and ammonia under very controlled conditions. Humification through peat ends in coal; caramelization through caramel ends in charcoal. If you growers do not think there is a difference in these two transformations, try growing your next crop on a bed of peat. All they have in common is a dark colour. Humification makes good casing. Caramelization makes good compost.

The mushroom is almost unique in being able to use as food the darkened, carmelized carbon compounds whether simple like sugar or complicated like cellulose and lignin. The amount of the caramelization is not too important and therefore the duration of phase 1 can vary and can be controlled by the temperature, the amount of ammonia present and the oxygen content of the air in the compost. Under the most favourable conditions with temperature in the range of 70 to 80°C and strong ammonia two days or so are enough. The problem is to get all of the material subjected to these conditions. In the usual 1.5 to 2 m. wide pile at most one half to two thirds of the substance is in these best conditions. Hence it is necessary to turn and aerate the rick in order to subject all parts of the pile to the desired state. The cooler outside where ammonia is low, air is abundant and the temperature is less than 65°C is actually being subjected to the phase II of composting and is losing food required for mushrooms as the carbohydrates are rapidly being consumed by the thermophilic microflora. Any parts where oxygen is lacking, on the other hand, are undergoing a totally different break down by thermophilic, anaerobic bacteria forming ill-smelling nitrogen compounds and organic acids actually toxic to the mushroom. It behoves the grower, therefore, to have his ricks built in such a way as to have a minimum cool exterior and anaerobic core.

The ideal condition is achievable and no single method of phase I composting is necessary. Usually, today, the compost is stacked in long ricks that can be mixed and aerated with a self-propelled turning machine, the dimensions being set by the necessity of having air penetrate all parts. Too many growers maintain an unnecessarily high moisture content during phase I, especially in the centres of their ricks. Since the outsides dry more, they should be wetter and firm enough to reduce the air flow and thus keep as much of the rick as possible at the high temperature and ammonia levels.

It is totally unnecessary to have any water seepage from the rick. Nor should any of the foul-smelling anaerobic core develop. These pollutants of the environment are one of our worst problems. They can and should be avoided at all costs.

For growers who cannot or will not master the art of composting Phase I without offending the environmentalists, an alternative has now been developed. I have been familiar with this clever system ever since its inception when the Sohm brothers in Austria talked to me about their plans. It does what it is supposed to do, performs phase 1 with a minimum of labour. It is computer controlled and operated from delivery of the raw ingredients to the final discharge of the compost at the end of Phase 1. The whole process goes on in tunnels with a controlled atmosphere and the exhaust air is purified of offensive odours through a big bio-filter bed atop the building over the tunnels.

Naturally such a system is elaborate and requires a big initial investment. The extra cost over that of a concrete composting area, open or under roof, together with the necessary turners and front end loaders can be at least partly offset by the saving in labour. For the grower who has his own capital or access to capital at a low rate of interest this system appears to be the answer in order to avoid being forced to close down by complaining neighbours. The two first users of the process, Sohm brothers in Austria and Kuhn Co. in Switzerland are succeeding. One essential to making it work is to have on the premises not only an expert at operating the computer panel but also an expert at maintaining and repairing computers should there be a failure.

The size of the operation may be another consideration. Whether or not such a system is practicable for composting the amount produced by the two Italian firms supplying compost or the CNC in Holland or Moonlight Mushrooms in America has yet to be determined. Moonlight Mushrooms, producing 3000 tons of compost per week, has been able to keep the odour under control even on an unroofed composting wharf (yard) so it is not interested. The CNC, I understand, is under great pressure from the authorities to abate their odour nuisance and may have to adopt the Sohm system. It will be a challenging undertaking.

Through the years other solutions to the composting problem have been investigated all the way from omitting phase 1 entirely to trying to shorten it in various kinds of ways. One of the latter was the use of revolving drums in which the raw ingredients were tumbled while being subjected to controlled heat and moisture for 24 hours. Such drum composters costing one million dollars each were installed by a big American firm at two farms. The process was unreliable as well as being expensive and was soon discontinued. One grower in Australia

used a smaller drum composter for some years but finally reverted to the standard open air rick.

Shortening, eliminating or modifying phase I has not resulted, as a whole, in commercial success. A recent letter from an Australian grower relates that the duration of his Phase I is now 40 hours successfully. Details of his method are lacking, but a report in the Mushroom Journal says he has attained yields 75% as good as on standard compost. One big advantage of the usual phase I composting is that the compost is softened and shortened by the break down of the fibrous substances during the caramelization allowing enough to be pressed into a bed to produce the size of crops necessary to complete in today's markets.

Phase II can be discussed shortly. All suppliers of compost and growers know that in Phase II the remaining ammonia must be converted by the thermophyllic microflora into protein as food for the mushroom. Remnants of easily available carbohydrate after the caramelization in phase I provide the carbon food. If too much carbohydrate remains after the protein conversion, unwanted weed moulds can grow and interfere with the development of the mushrooms. If too little remains because of so-called over-composting either toxic amounts of ammonia remain or the phase II conversion is unduly prolonged.

Today the process is carried on either in the final beds or trays or in especially built and controlled tunnels in bulk. The bulk system, as you know, originated here in Italy by Mr Enzo Giordani and Mr Bruno Francescutti and was adapted in Holland some 7 years later.

In Europe the bulk, tunnel system is becoming the prevailing process for Phase II. It does present advantages, but, as you also know, it has specific requirements that cannot be neglected. The time for conversion is not shortened. The use of the beds or trays is shortened per cycle and their durability is increased. They must, though, be thoroughly disinfected before new compost is filled into them. Less labour is required. For filling compost into bags or blocks on which mushrooms are grown bulk phase II is practically essential. Details of the procedure need not be discussed.

Why then has bulk, phase II composting not been widely adopted in North America. In the United States only three farms of any size have turned to the bulk process. The owners of one are very enthusiastic, of another are lukewarm and consider themselves stuck with the tunnels. The third, a rather close-mouthed multi-national food firm, is not saying much, but of the two farms using tunnels, out of many farms that the firm operates, one has so far been a disaster and the other has had big fluctuations in its productivity according to its competitors. This is despite the presence of Dutch experts on the staff. Other growers have tried tunnels and abandoned them or failed.

While there are a few central composting firms distributing phase I compost to growers in America this practice has not become well established as it has in Europe mostly because the farms are far apart and the cost of transport is prohibitive while small family farms are not economical. Where they are close together as in Chester County, Pennsylvania, sanitation does not reach European standards and compost finished through phase II in tunnels would run great risks of becoming contaminated with virus-infected spores or other mushroom enemies.

The mixing of the spawn through the compost at the end of phase II has, of course, become a standard practice throughout the world. In North America, at the same time, many growers now supplement their compost with nutrient mixed into the compost. This supplement is furnished by several suppliers who treat it to produce a delayed release. That is, the nutrient becomes available only after the mushroom mycelium has grown into the compost. The success of supplementation at spawning depends on thorough and uniform distribution of the material into the compost, else 'hot spots' can develop where the supplement is too dense. Amounts up to 4% of the dry weight of compost may be used but too much is likely to cause over-heating and damage to the growth.

Spawn growing in bulk using tunnels like those for phase II composting is practiced by many growers in Italy and several compost centres worldwide. The process was originated in Italy and was perfected through the years by the managers of CNC in Holland who realized the need for an absolute sanitary, germ-free environment to have this practice successful. Not only must the growth be under such conditions but also in vehicles transporting the product to the beds and filling them. Despite its success the CNC has not enlarged its facilities very much and the majority of the Dutch growers are not furnished with through-grown compost.

There are other compost centres and some growers in different countries who are successful in growing the mycelium in bulk, but many growers who might be tempted to follow this course are restrained by the danger of introducing virus or nematodes and other contaminants. My evaluation of this practice is that although tunnel spawn growing can be successful, it will never become a general practice in mushroom culture.

The only innovation in North America during so-called 'spawn-growing' or mycelial development is the covering of the beds with thin plastic sheets. Originally conceived as a method of protecting the beds from virus-infected spores, other advantages have been discovered, especially preservation of the moisture in the surface compost. As a result, the mycelial growth at the surface is very uniform and the moisture promotes rapid growth into the casing layer.

Most bed growers now use the plastic but rather few tray growers because the covering of the trays after spawning is not easy. Moonlight Mushrooms finds the plastic cover essential and has developed a semi-automatic method of applying it. Since 3,6000 sq. m per day are spawned the extra labour cost as well as the cost of the plastic itself is an allowable expenditure. There the plastic is removed just before casing except in the rare instances when the compost over-heats at the time of maximum growth of the mushroom about ten days after spawning. Then it is removed earlier.

Peat has become the universal casing medium with rare exceptions. One of these exceptions is Moonlight Mushrooms which produces all of its casing by decomposition of the spent compost for three to five years on the extensive farm land it owns above its mine. For the owners and for me the spent compost casing is far superior to peat. While its water-holding capacity is less than one fourth that of peat the mushroom can extract more water from it than it can from peat. I call this 'water-giving-up capacity'. Growers visiting the farm are simply astonished at the ability of prime

quality mushrooms to grow on what feels like dry soil. Another advantage is the ability of the casing to be rewetted once it has dried. It is unlikely that other growers will adopt this kind of casing so long as peat is available.

The Dutch growers and the followers of the Dutch system have adopted the practice of remixing the peat casing as soon as the mycelium has grown to the top of the casing layer. The remixed soil is then pressed back into a rather compact and very even layer resulting in an extremely uniform first break.

A less exacting copy of this practice has been adopted by some American growers known as roughing the casing. Instead of mechanically mixing, it is all done by hand with a rake or similar simple tool. The result is about the same so far as its effect on the fruiting is concerned. In both cases there is a delay in cropping of a few days, considered unimportant compared to the better uniformity of fruiting.

Of late, however, the addition of compost grown through with mushroom mycelium known as spawned compost or CACing (or compost added at casing) has become a common practice in America. MacCanna in Ireland introduced the practice in 1973 and the English growers enthusiastically adopted it to their sorrow. The virus prevalent at that time became rampant and caused a near disaster. CACing was discredited and remained so until resurrected by venturesome American growers where no virus was present. Today CACing has become widespread among mushroom growers with outstanding success. So far as I have heard, no case of virus disease because of CACing has occurred in the United States.

Moonlight Mushrooms depends entirely on CACing to regulate the first break of mushrooms. Not only are the mushrooms uniformly ready to pick fifteen days after the trays are cased, but also the break is at the surface rather than half a centimetre under the surface of the casing which causes dirty mushrooms. This latter advantage is perhaps most important since in the mine no manipulation of the air to force surface pinning is possible. On a farm, if there is any doubt whatever as to the presence of virus, CACing must be avoided. I have heard that the Dutch growers have attempted to substitute CACing for their soil mixing and that at least some growers suffered an epidemic of virus as a result.

Two spawn makers in Europe are developing a pure culture king of spawn especially to be added to the casing. If successful, this would allow growers to avoid spawned compost in case virus is a problem.

One last note which certainly would not concern growers here (Italy). Mushrooms can be safely washed by a new process developed by Dr Beelman at the Pennsylvania State University, safely from the standpoint of the mushroom and of the consumer. No hyposulphite or SO_2 is used. Several growers are using the process, but only very tight, young mushrooms can be washed successfully. I am not in a position to recommend it.

Video available on the cultivation of mushrooms in Taiwan

The Mushroom Museum in Nijmegan, Holland, has a video-production available with the title 'Chinese Fungi, cultivated in Taiwan'.

It shows the cultivation of Lentinus edodes (on a synthetic medium in plastic bags and on woodlogs), and Flammulina velutipes (on a sawdust-based substrate in bottles) in great detail. The growth of Hericium sp. Auricularia polytricha, Ganoderma applanatum, G. lucidum, Tremella fuciformis, Pleurotus cornucopiae and P. flabellatus are briefly discussed. The common Agaricus and Volvariella are not shown, still the film gives a fair view of the Mushroom Industry in Taiwan.

Contents:

The film starts with an introduction to Taiwan (geography, history, economic importance, agriculture) in 10 minutes, the rest of the 40 minute-film is devoted to the cultivation of mushrooms. The view behind this film is that fungi turn an agricultural waste into a good organic fertiliser and produce a protein-rich crop as well.

Booklet:

A booklet is distributed along with the film, discussing different methods of shiitake-cultivation and giving some background information on Taiwan. Basic information on the other mushrooms is also given.

Equipment used:

Recording has been done with a Sony CCD 200E PAL-system camera, editing on Umatic. The technical quality is not high enough for broadcasting, but adequate when played directly from videorecorder to television.

Ordering:

The film will be distributed principally on VHS-tape, you may inquire for the cost of other tapes.

Please mention the type of television-standard when ordering; NTSC (American) or PAL (European). The tapes will be sent within 6 weeks after receiving payment. The prices include handling and shipping per airmail of both the video and the booklet.

PAL-VHS: $ 65,- NTSC-VHS : $ 75,-

Payment can be done by transferring the required sum to:

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GEOFF GANNEY'S

GROWING PAINS

1st July

Type of chalk or ground limestone used in a casing mix may well have a greater influence than simply changing the p H. Not the least being density, moisture retention or micro-element changes. When using super-fine chalk some time ago the peat porosity changed and the mix appeared to become silted up. Gaseous exchanges became limited, panning extensive, evaporation poor and mushroom non-existent. Then again with a different type of peat it could all change.....

2nd July

Re-organised the watering system on the new turning machine in order to gain extra water for sides or to cut out water in the centre of the stacks. This should help us to gain more uniformity across the face of the heap and lead to a reduction in undercomposted areas. I suppose each grower has to adjust his own machine to suit his preferred system?

3rd July

Talking to growers from the South East confirmed that there are similar problems in recruiting enough picking staff. Irregular flushing and poor quality doesn't help, or the large variety of grade-out's you have to do. As one grower put it, maybe the type of mushroom we market will have to change to suit the labour available. Certainly the effect of harvesting on a mushroom business needs close evaluation.

4th July

Checked out watering equipment to ensure that the water droplet size is as required and the spread is as uniform as it should be. Must set up a proper 'test rig' which sounds familiar!? Amazingly often the most 'used' is the most 'abused' equipment on a mushroom farm, yet can be the most important.

5th July

Having reduced the density of compost at spawning some weeks ago has helped keep bed temperatures in reasonable bounds. I would imagine even with cooling high density filling with supplementation would rely on an extremely good compost to maintain temperature control. Any non selective material would quickly give rise to problems.

7th July

Some concern with regard to apparent increase in outbreaks of virus? Maybe instances of poor cropping are resulting in more samples being processed leading to a greater identification than other wise might happen. As always interpretation of problems in relation to cause is not always straight forward.

8th July

Useful service by Dent Bennett Chemicals Ltd of Luton who offer to sell on any good quality surplus chemicals to the general Agricultural Trade.

9th July

Made a note to get out to visit a few growers in order to clear the 'thinking box'. With today's daily drudge it becomes a dangerous sign when there is not 'set aside' enough time to discuss common problems with other producers. Nothing like discussions to promote new thinking.

10th July

Keeping labour costs under control on split production sites is by no means easy and at times impossible. How much can one dare reduce numbers without quality standards changing. Yet when does a system reach proportions where labour usage outweighs the potential output and therefore, whole systems require changing. Maybe the benefits of improved net return is destroyed by additional costs to achieve such a goal. One thing for certain is that daily control over cost expenditure is essential on todays mushroom growing unit.

11th July

Counted twenty different packs being used on the Marigold farm, no wonder labour costs can't be controlled.....

12th July

Very poor pinning on this week's fi flushes due to extreme temperatures a excessively high humidity at airing l week. Making a herald flush which wh we have cleared it should throw up proper first flush. From the telepho calls coming in it sounds as though ma growers have similar problems. Getti this across to customers is not easy understandably they want delivery their product and not excuses. Althou reasons may be more acceptable. W der which is worse; high temperature high humidity?

13th July

Struggling to keep on top of Verti lium on the Marigold farms and sudde realised daily removal of filters for wa ing in the heat pumps could release d (spores)! Possibly a problem but grea if we block up the air passages.

14th July

Mushrooms disappeared, gave me ti to study a most thought-provoking let from Mariet Vedder which now follo

Dear Geoff

After reading your 'Growing Pains the May issue of the *Mushroom Journ* I would like to respond to what you wr about your experience of April the fi your philosophy about a picker's knif

Indeed, I have studied the most i portant tool a mushroompicker h perhaps a little closer than most of y readers.

First of all, I would like to explain v I'm so interested in what you wrote ab harvesting in general and the cheap, nevertheless very important, tool; knife.

At the age of 14 I was already pick mushrooms at the small farm of friend's parents in Horst to help them c Since then I have spent a big part of life in mushrooms houses; picking mu rooms myself, training pickers on fa all over the globe and introducing n harvesting techniques and methods to prove the efficiency and also the qua of the product. We all know that mu room growing is not that easy and m and more developing into a science. improve the business we organize c

ences and courses, we write books and ıgazines and sometimes we have open uses to show off some good first ɛaks. There even is a kind of mush-ɔm doctor; Geoff Ganney, specialized *Growing* headaches.

Amazing for me is that at these con-ences or in these books or magazines, nous experts are talking or writing out compost, supplementing, cac'ing, ep scratching and the use of chlorine d the ideal CO_2 concentration and hy-ds and virus and marketing, but so ..... I have always missed harvest-g.

t seems that when we get to this, in my inion, most delicate and important part he mushroom business, almost every-dy is backing off; having no interest. ɔ the owners/managers of a mushroom m forget that the pickers are eating ay almost 60 - 70% of the (labour) pie? Don't they realize that a harvester can luence the quality of the product more ın any other growing factor?

We send our growers - area managers, mpost guys etc. to courses and meet-gs, sometimes even overseas.

Do we have any serious training pro-ım for the biggest work force, the rvester?

Are the mushroom growers dozing ?

They mechanized and computerized to fullest, but most of them overlooked my opinion, one of the most important ıd also expensive) areas.

t seems to be below the level of the signer-owner of a farm to discuss with pickers how to create the best harvest-conditions.

We do the utmost to get the mushrooms the beds and very little to get them off ɔperly.

May I offer your readers a suggestion off.....?

The best way to recognise the daily ɔblems in the harvesting area is; let the ss/manager pick mushrooms himself half a day or more. Then he will ure out that indeed it's very unpleasant constantly get a wet shoulder from that pping plastic airduct, or a stiff neck as result of the high air velocity in the le.

He never before realized that it isn't that ıch fun to sit on your knees on a cat-lk for hours to collect the white gold. That indeed the distance between the two beds was that little and that lowest bed so close to the floor. How frustrating it can be to pick just 12 kg an hour with hard work, because of mushrooms with a pieceweight of 160 in a kilogram and most of them almost open already, and somebody is asking if that room ever will be finished.

The boss then will figure out that there's actually more light in his toilet than in the growing rooms where 15 or 24 people are working for so many hours.

A king-size bed may be wonderful during night time but for picking the mushrooms at the centre of a bed, one should know that the maximum width should not exceed 140 - 145cm.

By picking himself he too will realize how unpleasant and itchy it is to have compost in your hair and neck because of poor construction of the sideboards or sloppy filling. Perhaps he never before realised that there are that many spots in the room with puddles of water on the floor. Not good for controlling blotch but very unpleasant to stay in too!

He will figure out that this stepladder is not as handy as he thought it was; that the space on the platform of the lorry is indeed very limited and that climbing on the trays goes far beyond his physical capability.

After that half day picking he perhaps will understand much better why many harvesters are constantly looking for other jobs.

Sorry Geoff, I almost forgot to tell you more about the knife. In my opinion, and I've quite a bit of experience, the best mushroom picker's knife is made by;

Diogenes - Werk - Herder & Sohn
Postfach 11 02 27
5650 Solingen 11
W. Germany

Phone: (0212) 7 70 71 - 73 Telex No. 8514 492 dio

Order No. 4602 for mushroom knife

If the mushroom growers in the more developed countries want to continue their business in the future, they'll have to pay much more attention and have to spend quite a bit of money to improve the harvesting situation. Although the Dutch developed a system for mechanized harvesting, we all know that for a high quality, fresh market product we still need human hands. For as little as appr. two German Marks we at least can put a good picker's knife in those hands.

Mariet Vedder - Van den Munckhof

15th July

We will no doubt reflect on how many letters are likely to be created after this monthly issue?

Straw harvesting underway and the quality of product looks extremely good from the local fen soils. But we shall have to wait a few weeks to savour the end product.

16th July

Sunday Times gives full coverage of the 'Peat Boom' that is laying waste huge wetland areas. Experts estimate only a further 10 years supply in Britain's lowland areas. The editor of *Landscape Design* said, 'rapid exhaustion would mean the horticultural industry would have to develop alternative composts from waste such as sewage sludge, domestic refuse and tree barks.' Maybe this industry will be able to market its own waste, provided another alternative casing is found!

17th July

Reduced watering even further to maintain a dry regime through this warmer weather. Gaining evaporative cooling with maximum air changes and hopefully we may gain some pinning. Suppose this summer will repay airconditioning expenditure.

18th July

Hardgill formation on white hybrid strain unsatisfactory for quality and again going to lead into reduced returns. Economic acceptance of material product failure is no longer feasible.

19th July

Chicken manure far too lumpy this week and with analysis of three separate loads varying from 3.5 to 6.5% nitrogen one wonders where uniformity can come from. Having thought through the possible options, the only reasonable suggestion was to rough mix 3 - 4 loads together then use as a blend. Then to

repeat the operation when the batch is used and take a blended sample to assess nitrogen levels.

20th July

High pressure persisting and keeping ambients close to 30°C which is bad news for mushrooms. Down go sales. Down goes yield. Down goes pinning. Down goes the work rate. Up goes the overdraft.....

21st July

Evaporation of crops pinning not exactly rapid. But even without any form of chilling they are just about pinning. For how much longer is anyone's guess. Heard the high pressure was moving into Holland which coincided with BBC4 programme on Agriculture's Pollution of Wasted, Ammonia and Nitrates in Holland. Over 100 million tons of ammonia waste a year! A frightening figure which as was explained, such atmospheric ammonia levels cause breathing problems, kill trees, and that the cost has to be met by the agricultural industry. Maybe the MGA will require an environmentally minded sub-controller. Was going to say green, buy maybe that wouldn't sound right!

22nd July

Reduced water levels in compost ricks to help get some chimney effect with air flow into the stacks. So far with the reduced width very little anaerobic core has been present at filling.

23rd July

Increase in false 'truffle' causing concern but no doubt it is basically the high temperature. But is it high at spawning or during the spawn run? What is high? Experience indicates low ammonia composts (low pH.) will lead to more prevalence of false truffle in the beds. Imbalance of C:N ratio in the compost also appears to give rise to more infected areas developing. This of course is not atypical with other weed moulds or competitors. John Fletcher always says to get false truffle spores to germinate is not the most simple thing to achieve.

24th July

Introduced some Dimilin treatment to anticipate any sciarid build up after this hot spell. Putting it onto the beds via application, although the proof will be in the results. Telephone call with regard to using *chlorfenvinphos* (Birlane) in the casing for *cecids* made me dig deep into the dim past to recall efficacy. Must ask Phil White when I next see him if any other development to control the cecid menace has been developed. Rather than 'killing' it seems that reduction in reproduction is more likely with some chemicals. Research into basics of controlling pests and pathogens is a continually on-going saga for when all seems well, something in the biology of the beast or the growing system changes and a problem occurs. Mushrooms historically are littered with such happenings.

25th July

Having decided to hold more mushrooms than usual in the cold store a fan motor goes up in smoke. As did both chillers on the market delivery vehicles. *Who have I upset.....*

26th July

Research panel meeting at the newly proposed site for the Mushroom Excellence Centre at Wellesbourne left me in two minds. Mindful of the great need for increased knowledge and mindful how to achieve the end result. This will be a subject much discussed (as it has for so many years!!) at the York Conference.

27th July

Grower magazine advertises under the Education section 'The Mushroom Growing Business' a regular slide show seminar. I suppose another commercialism to encourage producers into an oversupplied industry. What would be the MGA's official line to alternative crop seekers?

28th July

Gordon Pickering eastern region training group advisor tells me of increased activity in on-farm training and a greater awareness of growers to staff training needs. Hidden assets as many would say. Following up training with awareness benefits is as important as the training itself. The debriefing, the implementation and the follow up are part of the whole package. Must check to see if the 'Bath Short Course' type of training is to be re-introduced? Probably too simple just to call it the MGA Short Course.....

Membership update

We are presently updating our annual membership list. If you have changed address or phone number during the past 12 months please let us know so that the list can be as up to date as possible.

29th July

Continuous heat with daily ambients exceeding 31°C has somewhat discouraged buyers. With the first hot summer since 1976 we are now seeing if the expanded true consumption per capita is likely to stand up under a low demand situation. No doubt the eventual demise of mushrooms will eventually push up the wholesale price.

30th July

Telephone ringing continually with growers trying to buy mushrooms, where have they all gone?! Good quality in Covent Garden is 150p a pound this morning with the promise of more to come. But we only got 90p? Well of course the top price is for the top grade! The more one spends to attempt to provide top quality, the more one is vulnerable to also having to undersell the product.

31st July

What with falling sales, vastly increasing labour costs, intense overseas competition, a disastrous research and development situation, I will have to turn back the pages to consult the MGA five year priorities plan. Somewhere in there it will tell me where is the most advantageous area to put in effort and money.

Mushroom Marketing Worldwide

by **Aoife O' Brien** (Sales and Marketing Manager Darmycel (UK))

The current position, illustrated in able 1 shows that USA leads the orld, producing 285,000 tons (23.2%) the total *Agaricus* market.

In 1970 the total production figure as some 3.2 times less that the 1.22 illion of 1986. This point is further ustrated in Table 2 which shows the crease in production between 1980 d 1985. With the exception of one two of the Asian countries, (where oduction is very volatile) the in-eases in production are very nsiderable.

Major increases can be seen in:

Ireland	+157%
Mainland China	+100%
Holland	+ 75%
Spain	+ 66%
Great Britain	+ 53%

In the overall view of mushroom pro-iction, *Agaricus bisporus* and *torquis* account for some 56% of the tal market with Shiitake and *Pleuro-* the second and third most important ushrooms respectively (see Table 3).

Table 3. World production of edible cultivated mushrooms in 1986

Species	Common name	Weight ('000 tonnes)	%
Agaricus bisporus/ bitorquis	Button mushroom	1,227	56.2
Lentinus edodes	Shiitake	314	14.4
Volvariella volvacea	Straw mushroom	178	8.2
Pleurotus spp	Oyster mushrooms	169	7.7
Auricularia spp	Wood ear mushroom	119	5.5
Flammulina velutipes	Winter mushroom	100	4.6
Tremella fuciformis	Silver ear mushroom	40	1.8
Pholiota nameko	Nameko mushroom	25	1.1
Others		10	
TOTAL		2,182	100.0

Source: S.T. Chang, 1987.

Europe's total production makes it the leading market but the USA stands out as the largest individual mushroom market, with 23 per cent of total production.

USA

Looking more closely at America, the fresh market production there has increased some 200% since 1977:

1977	1982	1987	
150,000,000	320,000,000	460,000,000	lb

Source: USDA

Despite increases in yield and quality over the years the American industry set up an *ad hoc* committee in 1987 to:

"- examine the industry and to

- determine whether , consistent with anti-trust, agriculture and other applicable laws, some kind of unified effort could be implemented to improve the crop value to the industry's products."

It is from the Briefing Session report by the committee that the following information has been gleaned. The committee looked at all aspects of production from the strategic planning process right through to an 1988-89 business plan which would involve market research at retail and consumer level and a considerable promotional campaign.

"Let your imagination mushroom"

Some interesting facts and figures have emerged from their research. When they looked at the wholesale price of fresh mushrooms they found that:

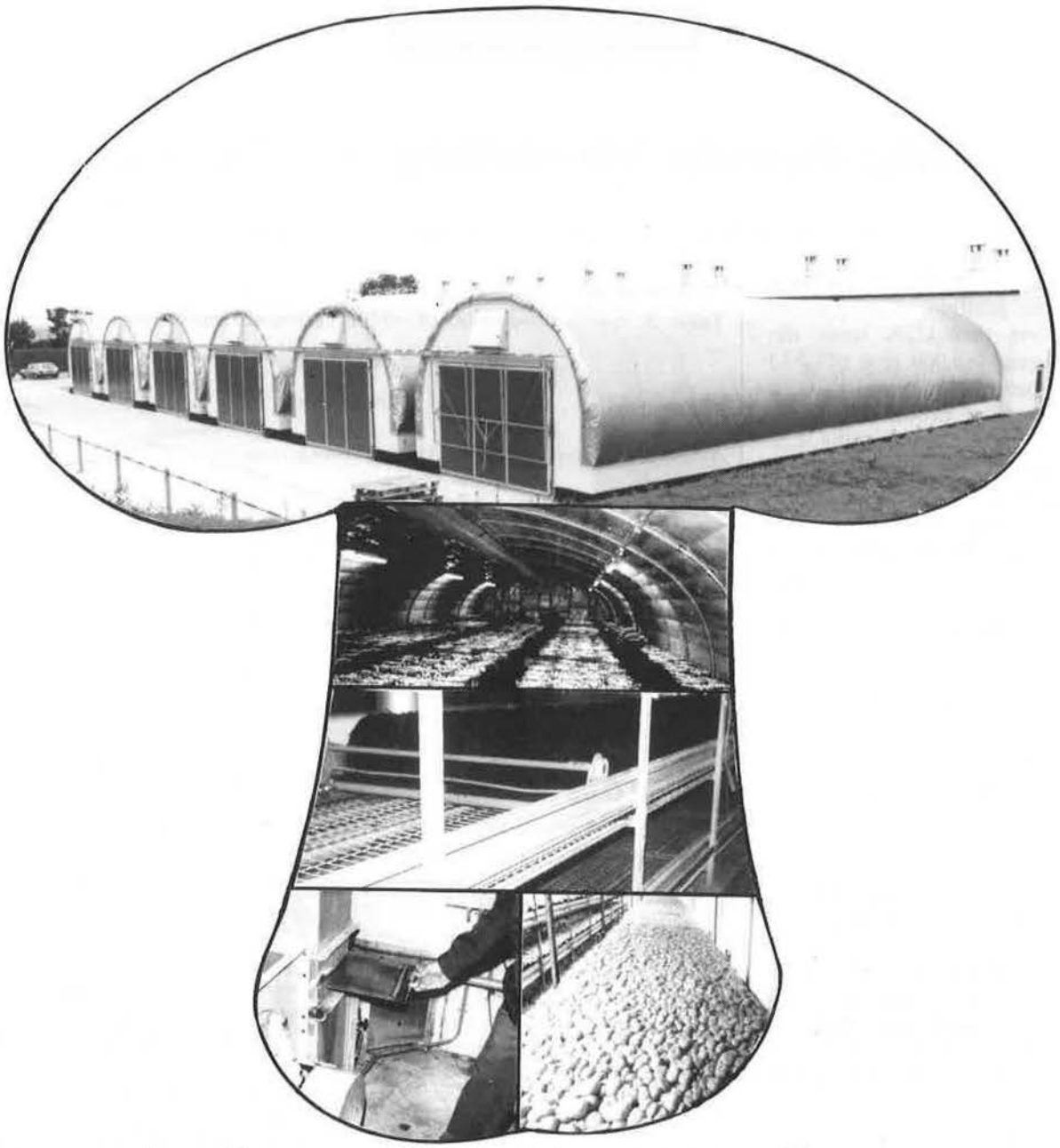
- it was not consistent over the previous 10 years

Table 1. World production of agaricus mushrooms in 1986

Country	(tonnes)	%
.. USA	285,000	23.2
2. Mainland China	185,000	15.1
3. France	165,000	13.4
4. Holland	115,000	9.4
5. England	95,000	7.7
6. Italy	75,000	6.1
7. Canada	51,400	4.2
8. Spain	45,000	3.7
9. West Germany	38,000	3.1
10. Taiwan	35,000	2.9
11. Yugoslavakia	18,500	1.5
12. S.Korea	18,000	1.5
13. Belgium	16,000	1.3
14. Ireland	14,000	1.3
15. Australia	14,000	1.1
Others	54,740	4.5
TOTAL	1,226,640	100.0

urce: S.T. Chang, 1987.

TUNNELS!



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since 1980 it had ranged from 93.5 nts to $1
ıe 1987 price was 98.3 cents/lb the ıolesale price of mushrooms had not pt pace with retail prices for food or : other perishables.

)n the consumer side:

ıly 65% of households had ever pur-ased fresh mushrooms for use at me
3% of households had purchased :m in the last year. Among such useholds they were bought on aver-e once a fortnight
ɔnsuming households bought 6.8 lb fresh product per year.

ource: Fresh Trends 1987 (The Packer) DA.

They found that the criteria used to ect mushrooms were:
colour (white)
size and
firmness
d almost all of the mushrooms were nsumed within 3 days of purchase.
The typical mushroom consumer was:
middle aged (30-49 years)
well educated
ıffluent
from the western region of the untry.
)f the mushroom consumers
97% had no brand preference
91% had no "geographic origin of ıshroom preferences".

t would be interesting to see how nsumers in the UK would respond.
The American Growers Association s directed much time and effort into research and from it they hope that ir industry will unite in support of objectives that "will bring a more nsistent and predictable prosperity" their mushroom industry.

Canada

The seventh largest producer in the rld, the 1986 production amounted 113,382,160 lb an increase of 14% r 1985. Of this 79,902,000 lb were d fresh and the remaining 33,480,000 were sold to processors.
ven allowing for this, 52,886,788 lb canned mushrooms and 5,757,615 lb fresh mushrooms were imported into nada.

Table 2. Mushroom production 1980 - 85

	1980 '000 tonnes	1985 '000 tonnes	Increase on 1980 %
1. **Europe**			
France	132	180	+36
Holland	60	105	+75
Great Britain	62	95	+53
Italy	44	60	+36
Spain	33	55	+66
W. Germany	35	35	0
Ireland	7	18	+157
Bel/Lux	13	14	+7
Denmark	7	9	+28
TOTAL	373	571	+45
2. **Other European countries**			
Poland	-	45	
Hungary	-	5	
Switzerland	4	4.5	
TOTAL		54.5	
3.**North America**			
USA	213	270	+26
Canada	29	45	+15
TOTAL	242	315	
4.**SE Asia**			
Mainland China	100	200	+100
Taiwan	64	52	-19
South Korea	25	10	-60
Japan	5.5	5	-10
TOTAL	194.5	267	+37
5.**Australia**	8	13	+55
TOTAL Worldwide	860	1,220	42

Consumption

Their *per capita* consumption of fresh mushrooms rose from 3.03 lb/head to 3.38 while their *per capita* consumption of processed mushrooms declined from 3.64 lb to 3.41 lb.

Since 1982 the "fresh" consumption has increased 49.5% while the processed consumption has decreased 0.6%. The total pounds *per capita* in five years has risen by 19.3%.

Other statistics that the Canadian Mushroom Growers Survey in 1986 established were that the area under production had increased by 4% to 6,833,000 sq. ft, with on average 4.17 crops per annum. The national average was 3.98 lb/sq. ft. (with Ontario 3.89 lb and British Columbia 5.02 lb).

Mushroom prices declined in 1986 with the market price down from $1.48 to 1.45 per pound and the processed market down from $0.70 to 0.61. Regional differences in prices do occur.

The optimistic pattern established up to 1986 was not carried forward into 1987 mainly because:

-Quebec's largest producer was strike-bound and shut down completely for most of 1987!

-Ontario experienced drastic decreases as virus became a problem specifically in one of its largest plants

-British Columbia, with over-production in 1986 and overstocks in its processing plant and facing a practically non-existent processing market due to low priced imports, had its growers cut back on production.

This resulted in:
- a fresh market output of 78,417,00 lb (down 2%)
- a processed output of 22,376,000 lb (down 33%)
- an imported fresh market of 7,417,000 lb (up 29%)
- and an imported processed market of 41,127,00 lb (down 22% on 1986 figures).

This in turn reduced the *per capita* nsumption by 1 lb to 5.79 /head/year (with most of the reduc-n in the processed sector i.e. 3.41 lb 1986 dropping to 2.46 lb in 1987).

The Canadian Mushroom industry is pecting - barring any unforeseen cir-mstances - a return to normal oduction levels for 1988 with a slight turn in overall prices.

Asia

Almost negligible before World War mushroom production expanded eatly in Asia after the war exceeding 0,000 tonnes in 1978. By 1987 total oduction was virtually 1,000,000 ton-s (Table 4). Mushrooms have oved ideal as a low cost crop that can grown successfully on small family ldings. The climate too provides ad-ntages over North European nditions:

- as expenditure on heating is either l or minimal, and
- as labour costs are low the mush-oms can be produced at very low st.

Canned mushrooms also lend them-lves readily to the export trade and, spite shipment costs, the low produc-n costs allow Asian mushrooms to mpete well on World markets.

Mainland China's production has ntinued to rise over the 70s and in 86, stands at 685,000 tonnes with *garicus* accounting for just 27% of its tal production. China is also the rld's largest exporter of processed ushrooms and all the indications are at production of fresh and processed ushrooms is likely to increase still fur-er over the coming years.

t is quite possible that we will see an crease in canned and dried mush-oms from Asia coming onto the ropean markets over the coming ars.

he majority of mushrooms produced in these countries are consumed fresh with around 30% canned. The canned product can make a considerable contribution to the economy of these developing countries.

Table 4. Asian production of Edible Cultivated Mushrooms in 1986 (tonnes)

Country	Agaricus	Lentinus	Volvariella	Pleurotus	Auricularia	Total
Mainland China	185,000	120,000	100,000	100,000	80,000	585,000
Japan		160,000				160,000
Taiwan	35,000	32,000	12,000	8,000	35,000	122,000
Thailand	380	15	60,000	5,760	3,920	70,075
S. Korea	18,000	880		36,000		54,880
Indonesia	150		4,000			4,150
Hong Kong			1,200			1,200
Philippines	500	30	200	30	150	910
India			300			300
Singapore		120		120		240
TOTAL	239,030	313,045	177,700	149,910	119,070	998,755

Table 5. Rest of the world.mushroom production (tonnes)

Country	1977	1980	1986
Australia	7,000	8,000	14,000
South Africa	3,000	3,000	11,000
Brazil	6,000	8,000	6,000
New Zealand	2,000	2,000	5,600
Israel	N/A	N/A	850
Guatemala	N/A	N/A	50

In the other world regions, mushroom production has increased slowly with Australia and South Africa making up the bulk of the production.

Europe EC production

Moving closer to home, mushroom production has continued to expand over the 1970s and 80s with France the largest producer in the EC (Table 6).

The import and export of mushrooms between EC countries makes interesting reading, particularly with 1992 in mind.

Tables 7, 8, 9 and 10 illustrate the volume of mushrooms currently being imported and exported by member states. Holland exports the greatest volume of both fresh and processed mushrooms and is second only to China in the worldwide export of processed mushrooms.

All of this is set to change in 1992 with the establishment of the Single European Market as ratified by the 12 national Parliaments in 1987.

The main points of the Single European Market are that there should be:
- no customs officials
- no passport checks
- no documentation requirement of any kind.

Member States "will be able to restrict imports on genuine human, animal or plant health grounds".

Some of the more important consequences of the act are:

a closer monetary union between Member States which would probably involve all currencies, including sterling, joining the Exchange Rate Mechanism of the EMS. This would reduce price fluctuations of imported mushrooms.

Mushrooms along with other primary agricultural products are at present relalatively free of restrictions. The

Table 6. Agaricus production in the EC 1977-86 ('000 tonnes)

	1977	1980	1983	1986
France	113,100	131,700	146,400	165,000
Holland	45,000	60,000	81,000	115,000
Great Britain	59,000	61,800	69,600	96,000
Italy	34,680	38,500	40,300	45,000
Spain	20,000	33,000	40,000	45,000
W. Germany	31,000	35,000	35,000	38,000
Belgium	11,500	13,000	14,500	16,000
Ireland	6,300	6,860	11,000	16,000
Denmark	6,880	6,600	8,100	9,300
Greece	300	400	N/A	1,300
TOTAL	327,000	386,860	445,900	545,600

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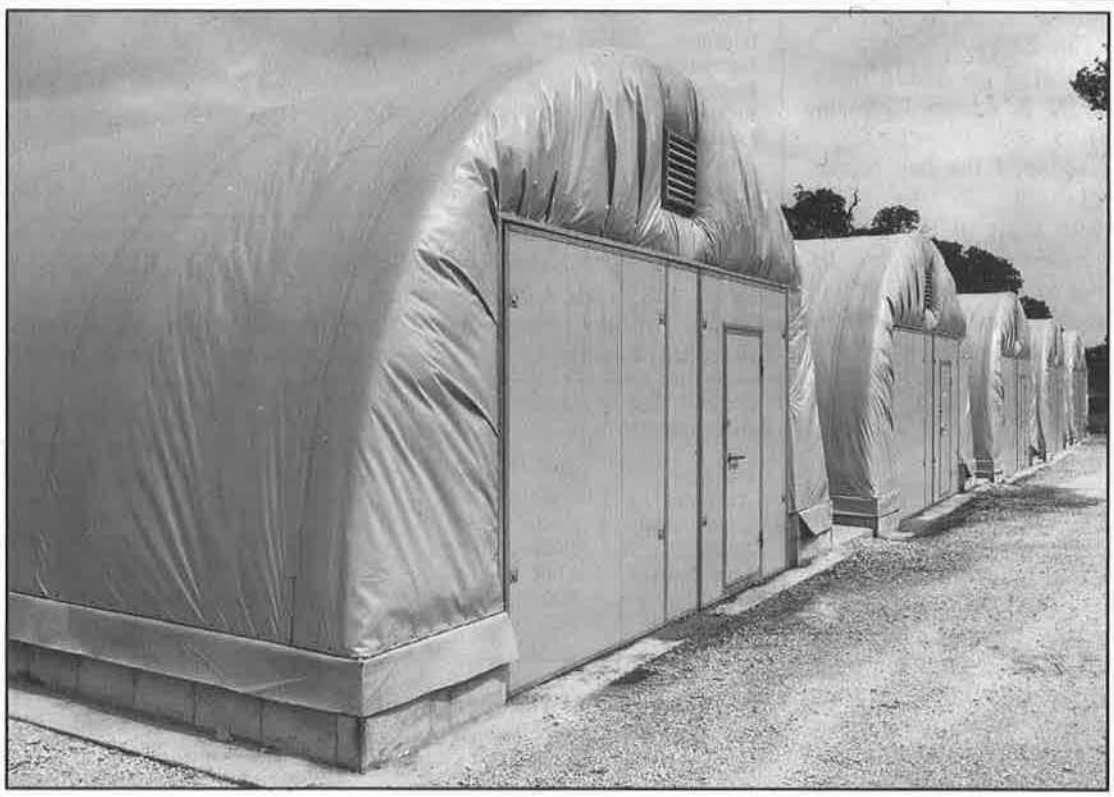

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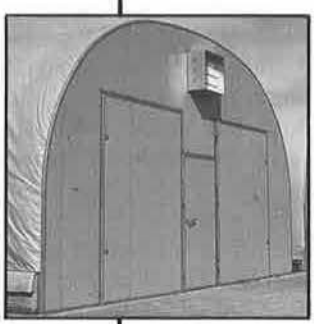

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Table 7. Export of fresh mushrooms from EC countries ('000,000 lb)

Country	1980	1983	1985	% Share in 1985
Holland	7.88	12.17	27.37	35
Ireland	10.91	11.57	20.35	26
France	3.34	9.20	13.79	17
Belgium	2.42	2.71	10.78	14
Denmark	1.91	1.39	1.03	1
Other EC	0.92	3.04	5.78	7
TOTAL	27.39	40.06	79.20	100

rriers that do exist, including vari-
ons in pesticide legislations, will
ve to be clarified.

current zero rating on food.

Full details of the Single European Market and 1992 are available by tele-

Table 8. Import of fresh mushrooms in EC countries ('000,000 lb)

Country	1980	1983	1985	% Share in 1985
England	12.17	17.78	34.98	45
W. Germany	7.59	9.33	19.54	25
* Holland	4.16	9.48	17.01	22
Belgium	2.90	1.36	5.15	6
Other EC	0.26	0.66	1.74	2
TOTAL	27.10	38.63	78.41	100

ırce: Eurostat

[olland exports mainly for processing. The mushrooms are usually then re-exported either canned bottled.

As a unified market becomes a real-
, it will give added impetus to the
ovement towards unified European
mpanies and cross-border mergers
d acquisitions.

phone from 01 - 200 1992.

EC quotas of preserved mushrooms

The EC, amongst other things, sets fixed import quotas of preserved mush-

Table 9. Export of processed mushrooms from EC countries (000,000 lb)

Country	1980	1983	1985	% Share of 1985
Holland	107.6	161.3	213.4	60
France	110.2	111.3	135.3	38
Belgium	5.7	3.5	4.0	2
Other EC	5.5	1.8	2.4	
TOTAL	229.0	277.2	355.1	

On VAT it is proposed that there
ould be two permissible bands of
es, a "normal" rate of between 14
d 20 per cent for most items and a
educed" rate of between 4 and 9 per
nt for "sensitive" items such as food,
oks, newspapers and transport.
he UK would then have to abolish its

rooms. The 1987 figure allowed 34,750 tonnes to be imported from Third World Countries ie:

Mainland China	22,275 tonnes
South Korea	3,000
Taiwan	2,306
Hong Kong	434
Others	1,735

Table 10. Import of processes mushrooms in EC countries (000,000 lb)

Country	1980	1983	1985	% Share of 1985
W. Germany	247.3	252.6	279.6	73
Belgium	29.7	28.4	33.2	9
Holland	1.8	11.7	18.3	5
Italy	2.9	8.6	19.4	5
Denmark	4.6	7.5	10.1	3
Other EC	4.4	11.7	22.2	6
TOTAL	290.6	320.3	382.8	100

Of the total quantity of mushrooms imported 94.5% went to West Germany. With the increase in production worldwide, and as consumers acquire a taste for the more "exotic" mushrooms, it is likely that the import quotas will be raised and that we will see more Third World mushrooms on the European markets.

France

It is clear from all the statistics shown to date that France at 165,000 tonnes is a major producer in the worldwide market. Exporting only 14,000 lb of fresh mushrooms, it sends abroad a considerable quantity, ie 135,300,000 lb, of processed mushrooms. Most of this is destined for the West German market.

Holland

The Agra Europe magazine of August last year stated that "there were better times for Dutch mushroom growers". Although the mushroom sector had been through a depressed period the article stated that the Dutch are now benefitting from the large number of farm closures in Southern Europe as production in Spain, Austria and Italy had declined by about 20%.

The 1985/86 year had been a bad one for the Dutch industry with average profitability below zero. Auction prices of FL 2.09/kg in 1986 were about 25% down on 1985 and almost FL 1 less than 1984. Despite this fall in prices the area had expanded by 7% to 86.7ha; the number of growers had increased by 2.5% to 867 and production had risen by 6.6% to 112,000 tonnes.

Turnover amounted to FL 500 million of which about FL 250-275 m went back to the growers.

About 75-85% of production came on the market as canned produce of which 80% went as export. The export figures in Tables 7 and 9 illustrate the Dutch domination of these markets. As much as 75% of total mushroom production is exported, with exports of fresh mushrooms rising in 1986 by nearly 70% from 12.4m kg in 1985 to 21m kg in 1986. Especially sharp increases were recorded in sales to the UK and West Germany!

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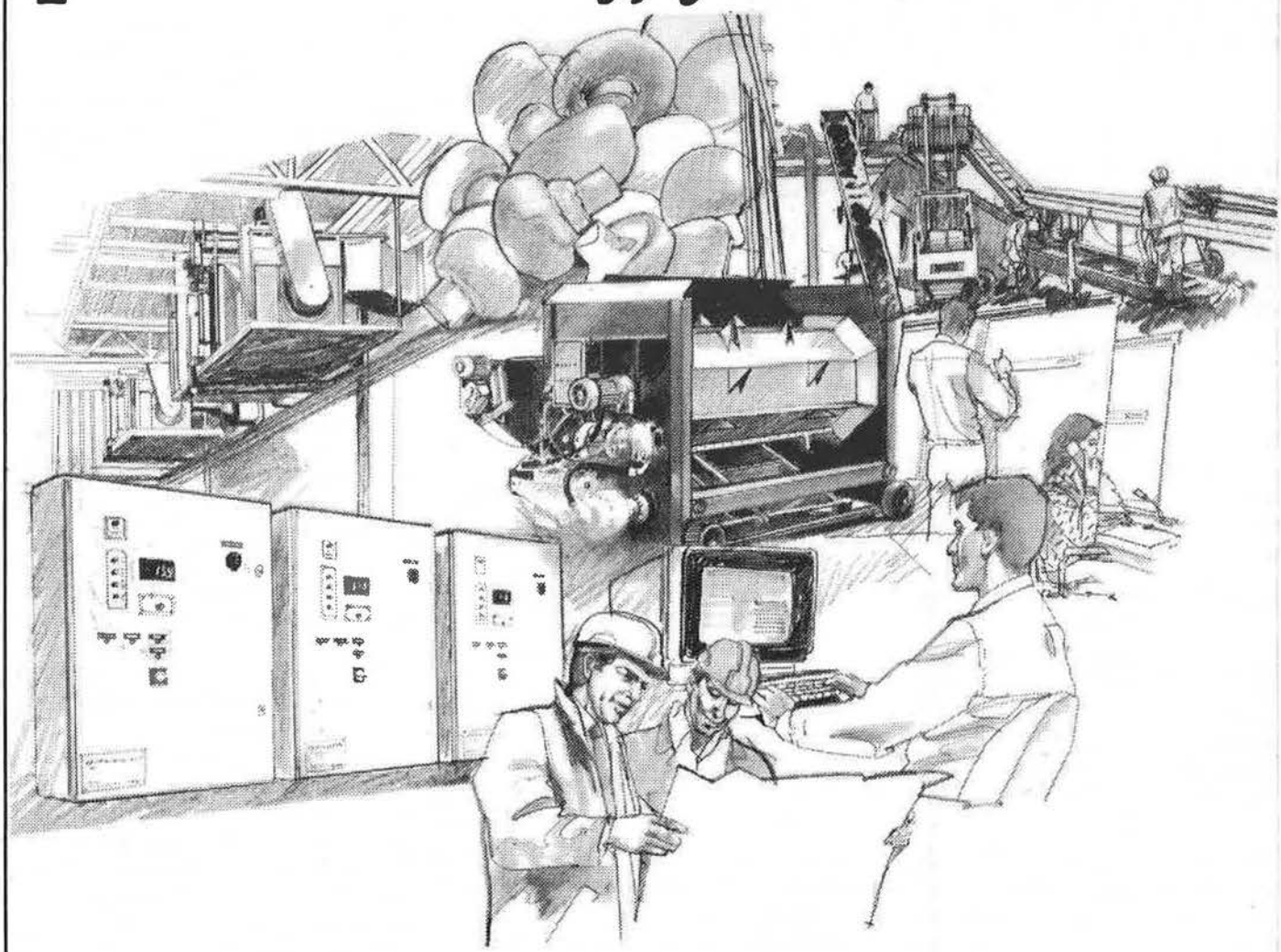

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Table 11. Irish Mushroom Production 1974-1986 (tonnes)

Year	Total	Fresh export	Processed export	Fresh home	Total Value £IR millions
1974	4,500	3,439		1,061	2.2
1979	6,600	4,762		1,838	5.9
1984	13,946	5,910	5,050	2,986	15.7
1985	17,400	9,251	5,992		19.4
1986	18,130	8,529	5,745		20.0
1987	20,000+	14,000		6,000	21.5

ter McCanna AFT National Mushroom Conference 1985

Ireland

Irish mushroom production has al-ays been a part of the UK picture, porting 4,000-5,000 tonnes per num to Britain in the 1970s (Table). With the advent of centralised mposting and satellite growing the ish industry has expanded rapidly er the 80s.

The Bord Glas (The Horticulture ard) are predicting that production ll double in Ireland over the next five ars. In 1987 the industry created er 80 new jobs and a further 250 part-ne. Creating jobs is an important nsideration for the Irish economy. long with job creation, mushrooms ve the advantage over most other rticultural crops in the their produc-n is by and large unaffected by the eather!

ii) the switch in production away from the traditional tray system to the cheaper system of plastic-bag growing in insulated polythene tunnels.

In 1987 there were 225 mushroom growers in Northern Ireland employing 300 people full time and an additional 700 part time.

About 70% of production is "exported" to Great Britain but local producers have come under increasing pressure from mushrooms imported from the rest of Ireland which have captured a substantial share of the supermarket trade.

The Northern Irish Industry is set on expansion and as Lord Lyell, Parliament Under Secretary of State, opened the new mushroom training unit at Greenmount Agricultural and Horticultural College in December of last year, he commented that the "the future viability of the mushroom industry depended on the efficient production and marketing of top quality mushrooms".

The new facilities at Greenmount, were he said, "aimed at providing growers with the opportunity to become skilled in the latest production and marketing techniques". It would seem that the training courses run at the new unit in Greenmount have been very successful and a great asset to the Northern Irish Industry.

Table 12. Production in Northern Ireland 1982-86

	1982	1984	1986
Output '000 tonnes	4.7	5.6	8.2
Price £tonne	994	1,214	1,102
Value £'000	4,617	6,797	8,984
p/lb	45.0	55.0	50.0

Northern Ireland

The Northern industry has also ex-nded rapidly in the 80s and was lued at £9m in 1986 (Table 12). Between 1983 and 1986 production s expanded by 70%. The increase in oduction has been attributed to) the introduction of bulk pasteurisa-n, and . . . . . .

Scotland

Mushroom production in Scotland is an up and coming influence on UK output with several new farms coming into production over the last two years or so (Table 13).

Table 13. Production in Scotland

	Area (ha)	Yield (tonnes/ha)	Output (tonnes)
1985	16.7	144.1	2407
1986	18.1	165.7	3000

Tremendous optimism currently exists in the Scottish industry with more new people coming into the industry; consumption is rising as is production.

Southern markets are bound to see an increase in Scottish mushrooms as their production escalates.

England and Wales

Finishing up on the home market, the official mushroom statistics currently read as follows:

- consumption: 5 lb per head per year and rising i.e. £4.70 per head per year spent on mushrooms which is equivalent to just 1.6 oz or 8.9 pence per person per week

- area: in 1987 was approximately 55,000,000 sq. ft

Table 14. Production in England and Wales

Production	1977	1980	1983	1986
Output '000 tonnes	53.9	61.3	76.4	100.1
Average farm gate price, £ per tonne	755	1011	1025	1101
Value of output £'000	38,503	61,951	78,276	110,186

Source:-MAFF


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output: from 1977 to 1986 has ıbled but as can be seen in Table 15, ıas still not kept pace with the ever

Table 15. Imports of fresh mushrooms into the UK (kg)

Fresh	1986	1987	Share in 1987
France	618,925	68,346	.3%
Belgium	3,071,808	3,252,482	13.7%
Holland	9,143,842	9,614,356	40.6%
Ireland	8,425,827	10,718,328	43.3%
Total	21,271,279	23,670,782	

reasing volume of imports
number of growers: now 297, repre-
ıts an increase of 39% on 1981 but
% of English productionn is still in

Table 16. Wholesale market prices p/lb.

980	1981	1982	1983	1984	1985	1986	1987
4.2	52.3	56.9	59.9	61.2	60.9	62.1	61.9

hands of the big three producers.
ooking at the wholesale market
ces from 1980 - 1987, the price trend
ıot dissimilar to those found in the
ıerican survey ie:
that prices have not been consistent
r the last 10 years.
ıs can be seen from the figures, the
ces have increased at approximately
ence per pound per year. These do
compare favourably with the in-
ase in production costs seen over the
ıe period.
lowever, what must be taken into ac-
ınt is the increasing percentage that
being sold through multiples and
er retailers and the diminishing in-

fluence of the wholesale market (see Table 17).

All the indications are that mushroom production is going to continue to increase for the foreseeable future. In 1992 the home market will become the home market of all 12 member states of the European Community.

The UK industry has responded well to the challenge of the 1980s but it must now meet the new challenge of the 1990s. With consumption equivalent to just 8.9 pence per person per week and with a pint of beer around £1 per pint, mushrooms have tremendous scope for improvement.

**Aoife O'Brien has for the last four years been the Specialist Mushroom Adviser for the South East of England, working for the Ministry of Agriculture Fisheries and Food's advisory service ADAS. She has recently been appointed Sales and Marketing Manager with Darmycel (UK).

able 17. Distribution of mushrooms in the UK.

	1981		**1986**	
	Thousand tonnes	Percent	Thousand tonnes	Percent
otal production	59.2	100	69.1	100
irect to tailers upermarkets & ıain stores	21.1	36	20.7	30
ther retailers			5.7	8
o wholesalers	32.2	54	33.2	48
o processors	5.0	8	4.6	7
irect to onsumers			1.7	2
ll other isposals	0.9	2	3.3	5

rce 1986 MAFF Mushroom Society Survey

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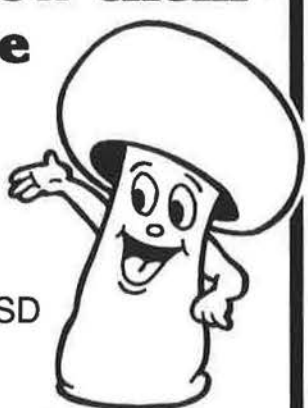

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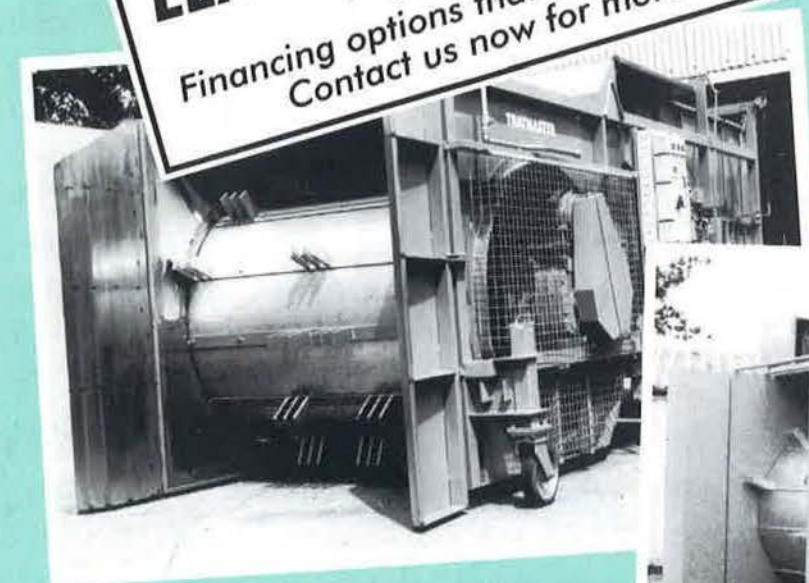

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