

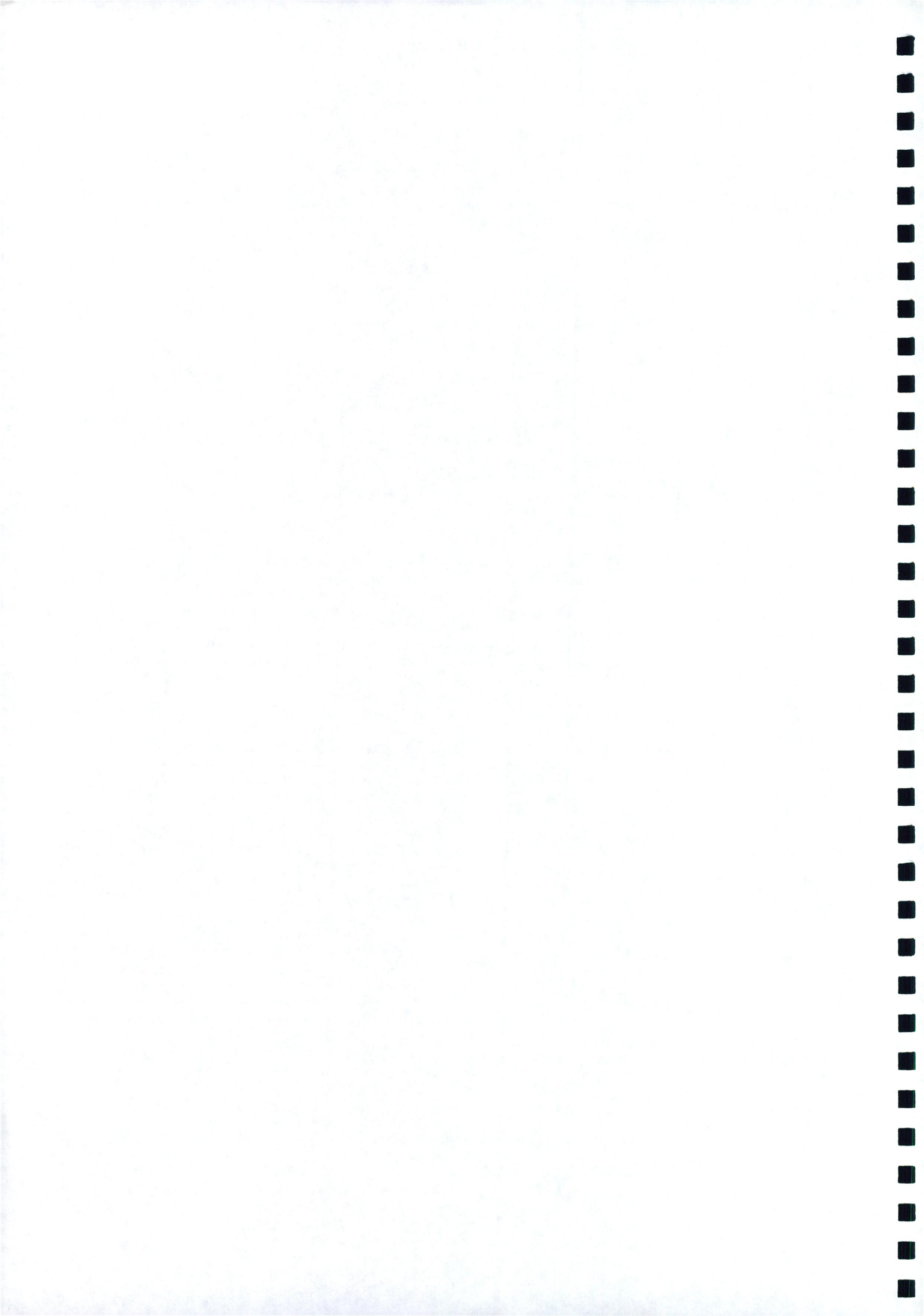


National College of Art & Design  
Faculty of Design  
Dept. of Industrial Design

**Contemporary Tractor Design**  
*by*  
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Submitted to the Faculty of History of Art and Design  
and Complementary Studies  
in the Candidacy for the  
Degree of B.Des. in Industrial Design

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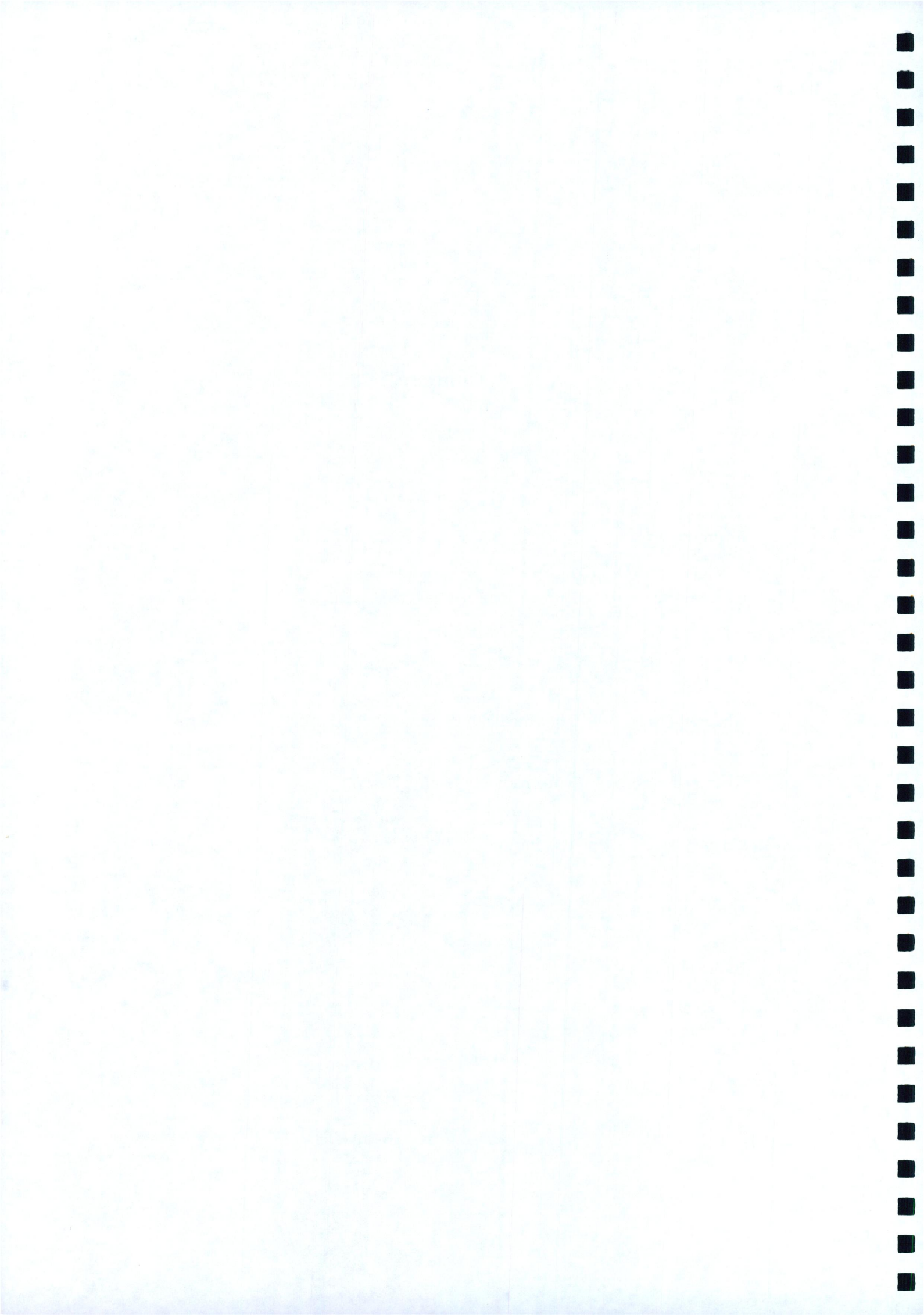
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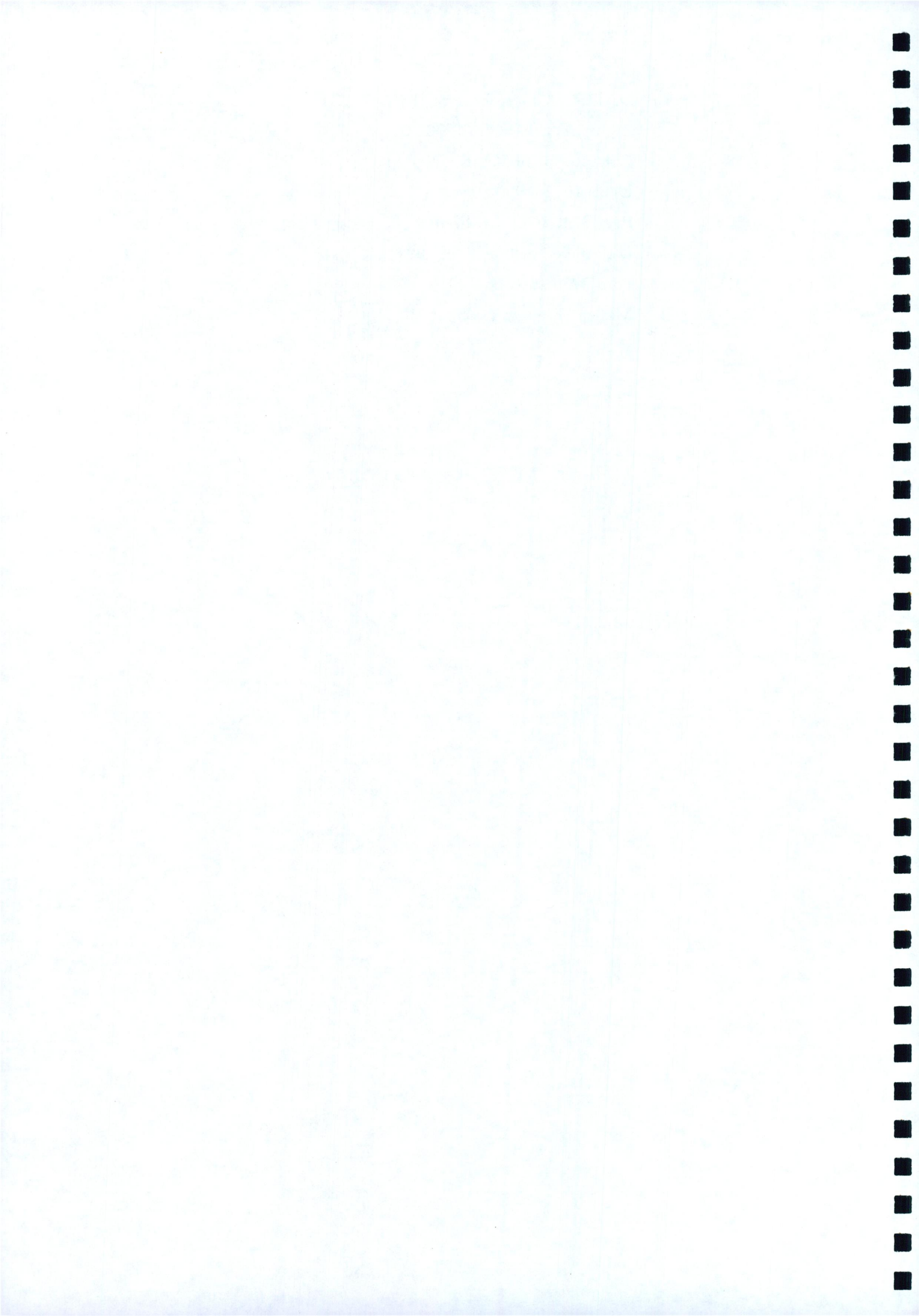
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## Introduction

Tractor design has had a massive input into determining the way we live our lives today. One might ask why is this? Well, if we go back all the way to



*fig.1*  
*Farmers examining the first ever steel plough in 1837*

1830, we will see that until that time, ninety five per-cent of the worlds population worked on the land. This huge proportion of people could only produce enough food for themselves and barely enough for the remaining five per-cent who lived in what were then called

'towns'. With such a great number of people needed to produce food and shelter, it was hardly surprising that the only existing professions besides farming were those that were of vital importance to the existence of mankind such as doctors who were few and far between. Leisure was also a scarce commodity for the harvest was too important to be neglected. When harvest time did arrive each year, it was a case of all hands on deck. If the harvest could not be saved, food shortages were imminent. Because the only sources of power were human and animal, man was too often dependant on the weather to be kind towards him so it was plain to see that the production of food was a risky business. (International Harvester promotional leaflet, 1975, p.6 )

In 1831, the wheels of change began to roll for the world. Cyrus Hall McCormick invented the first ever mechanical reaper. What the reaper did was to put in motion the mechanised progress of agriculture. No longer was there the need for such a collosol work force on the land. One man equipped with a reaper could now do the work previously done by up to eight men.

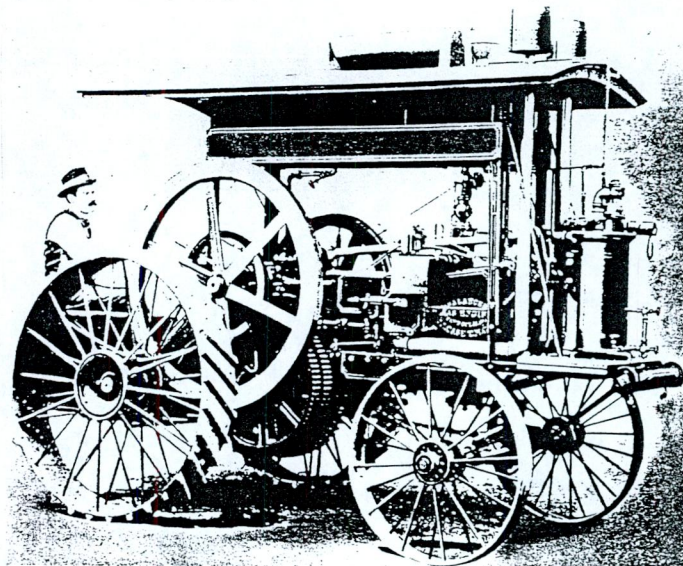




(International Harvester promotional leaflet, 1975, p.7.) This revolutionary progression now allowed people to concentrate on other activities besides farming. It was the beginning of the formation of our society as we know it today.

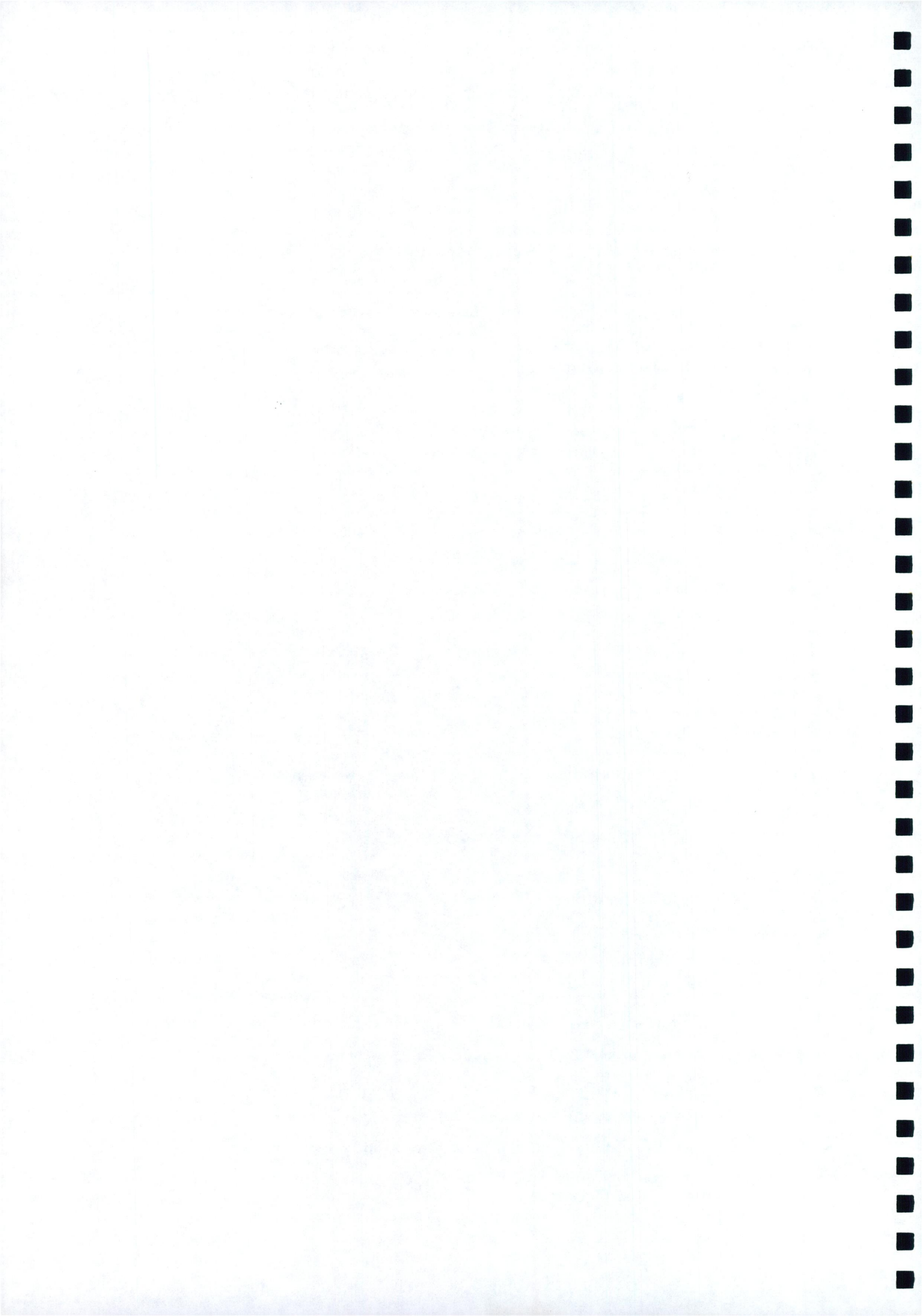
The invention of the reaper was step one on the road to the mechanisation of farming. The next step was to find a replacement for the horse. In the nineteenth century, horses and mules were the sole providers of power besides man himself. As helpful and all as they were, their work output was very limited and could not compliment the design improvements made in agricultural machinery as can be seen in *fig. 1*. The two largest reasons for this were that, one, they needed to be well looked after and needed a lot of attention, and two, they needed their own private patch of land in order to graze on. Land was an expensive item and it was not the desirable thing to have horses and mules using it as pasture. There was only one alternative and that was that the animal power would have to be substituted by another source of power, meaning mechanical of course.

In 1889, the first tractor was produced and so began step two of the mechanisation progress of farming. Although this first tractor was a cumbersome creation, it showed that there was an alternative to animal power and that

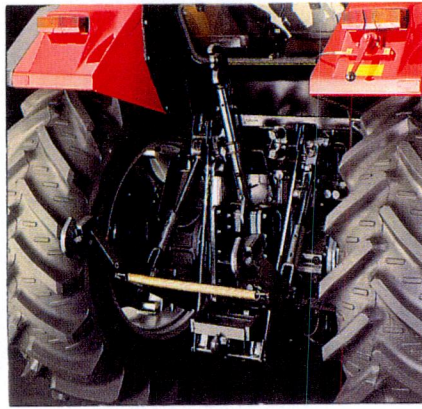


*fig.2*  
Case prototype tractor, 1892

if this alternative could be developed, never again would mans survival depend on such tempremental things such as the weather or animal power. For the following fifty years, many different types of tractors appeared on the market. Each had its own fine qualities that slowly but surely was leading to the ultimate elimination of animal power from the farming business. Until 1942 though, tractors were lacking immensely in design quality. The tractor







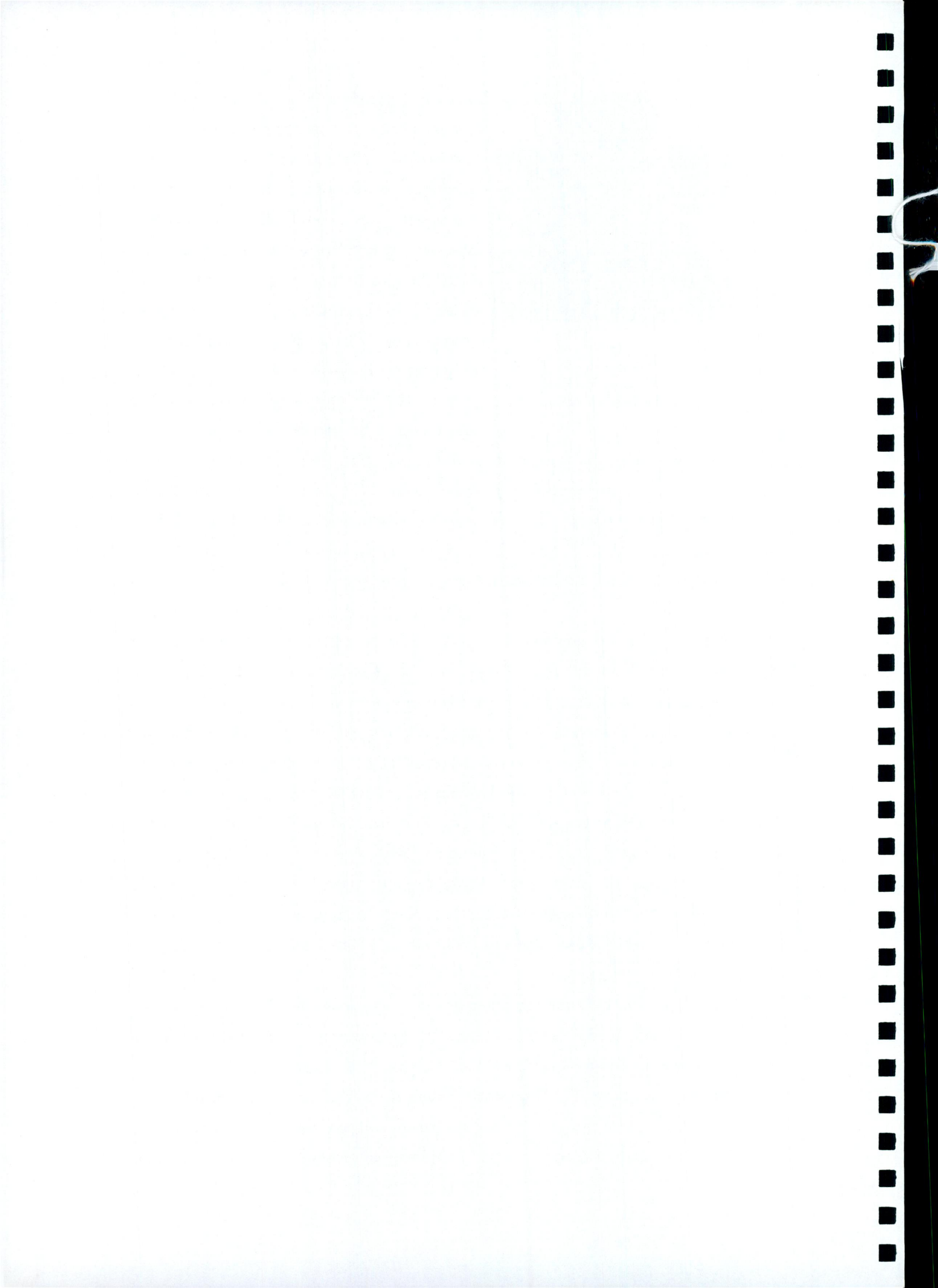
*fig.3*  
*This 3-point linkage on Case International 1455XL is based on Harry Ferguson's original Ferguson System.*

industry consisted of many different companies who all had their own ideas on how tractors should evolve. Each tractor company produced their own range of implements which could only be attached to their own tractors. In 1942, the greatest step in the history of tractor design took place when an Irishman named Harry Ferguson produced the first ever tractor equipped with the patented Ferguson System. This was a system that allowed a multitude of implements to be attached to the back of the

tractor and to be raised up and down with the aid of hydraulics. Until then, all implements were trailed behind the tractor. This proved to be very awkward in small fields but with the new system, the size of the field no longer mattered. This system has proved to be so successful that it is still used today on the most modern of tractors as can be seen in *fig.3*.

Step two was now complete so we now entered a new era, step three, which was the development of the tractor so as to make it more user friendly. Until now, tractor 'designers' had never taken into account the needs of the people who would be operating their tractors. As a result, tractors had an atrocious safety record and ergonomics were practically non-existent. With farming, efficiency is the order of the day, and in order to be efficient, one must be productive and alert. Since 1940, we have had two different eras in tractor design. Up until 1970, tractor designers were concerned with performance moreso than any other area. From 1970 onwards, the design emphasis switched from performance to user comfort, meaning both the development of cab design and easier access to maintenance points around the tractor.

This thesis will examine the latter of these two design eras and show us how tractor design blends both form and function superbly in its quest to create flawless solutions for the three main directives of tractor design; *productivity*, *efficiency* and *safety*. This examination will show the developments that have taken place over the past twenty five years and explain their consequences. Primarily, these developments will be split up into two different groups; those





that have taken place outside the cab area and those that have happened on the inside. Explanations as to why these developments took place will also be sought after. When this examination is complete, the combination of tractors and computers will be looked at and finally, we shall look at the design and marketing philosophies of various tractor manufacturing companies and see how each individual company tries to succeed in an industry that has one of the most competitive markets in the world. The design approach taken by Eastern block manufacturers shall also be examined and an explanation given as to why these tractors, even though they are of inferior quality in design and construction to any western built tractor, are by far the best sellers on the Irish market today and have been for the past decade.



## Chapter One: Performance & User Accessibility

Up until the year 1970, tractor manufacturers invested most of their financial resources into tractor performance. The reason for this was basic enough. It was only thirty years previous to this when the first ever mechanically sound tractor was built; Harry Ferguson's *Black Tractor*. From this point onwards, farmers were looking for perfection with engine performance, hydraulics, transmission etc. There was never a consideration given to the human factor. What resulted at the end of this thirty year period was that tractor design had remained unchanged to the naked eye but the performance figures had increased greatly.

In the middle nineteen fifties, tractor power output was limited in the region of sixty horsepower. With such a limited outlay of power available to the farmer, the size of implements used by him was greatly restricted. For the small farmer this was not a major hinderence but with the larger more productive farmers, it meant the purchase of a larger number of tractors in order to get the work done. As a result, the fifties proved to be a boom time as far as tractor sales were concerned. By nineteen sixty, tractors had improved on their predecessors solely by becoming reasonably functional and reasonably reliable.

Farmers and agricultural contractors in the fifties and sixties were not afforded the technological and mechanical comforts that we have today. To sit into a tractor from three decades ago and drive it, the first and immediate difference to come to light is the absence of power steering. Power steering is now standard on all tractors but to drive a tractor without it can be quite a tiresome experience if one spends a long time in the seat. Not only is driving a tractor without power steering strenuous, but it is also dangerous. When driving a tractor without power steering, it essential to keep a firm hold of the steering wheel at all times. This though is virtually impossible to do for long periods of time. When concentration begins to flounder, the risk of injury increases due to the possibility of a kick-back from the wheel. This happens when one of the front wheels enters a rut or hole in the ground or drives over some obstacle. When this happens and the front wheel fails to







negotiate the problem, that wheel shall remain in the same spot while the tractors steering then starts to pivot around this fixed point. The steering wheel then twists in accordance with this action thus creating a rather violent kick-back. Depending on how one is gripping the wheel at the time, the possibility of breaking a thumb is ever present. Today with power-steering, there is no longer such a problem. Tractors of over two hundred horsepower can be steered easily with just one finger. Because steering is no longer an arduous task, fatigue as a result no longer exists. This in turn creates a more efficient work rate which is one of the basic aims of tractor design.

Transmission systems have also undergone dramatic change in the last twenty five years. In the late sixties, International Harvester introduced a hydrostatic drive system which they claimed was the simplest form of transmission available at the time. It had already been used in many parts of the world so there was nothing new about the system except that this was the first time that it had been applied to tractor design. They also introduced a synchromesh gear system that was supposed to give the driver an "automotive type" gear change. (International Harvester advertisement brochure, 1971.) This was the first time that designers had tapped into the car industry for design ideas. International were the first to start equating their tractors with

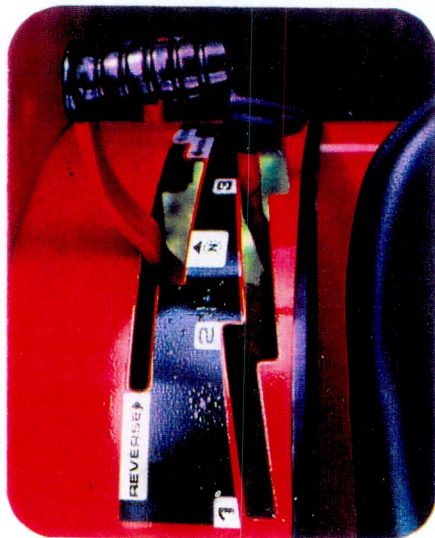


fig.4  
International Harvester's Synchromesh gear  
system, 1971

cars. Of course they had their reasons for making such a move. Their tractors had all the power and mechanical capabilities equal to that of their rivals so, in order to get ahead in the market, they introduced a new comfort element to their machines. Alas, International were a little too early introducing their gear shift system because it proved to be a little bit unreliable. The gear box used by International tended to get stuck during gear changes if one was rough with the system. This was by no means a regular occurrence but for it to happen once was too often in itself. All that aside though,

compared to what was on the market at the time, these tractors were streets ahead in terms of driving simplicity. The gears slid up and down in a straight





line unlike the standard H system. This new system made gear selection so simple that even at the tender age of ten years old, I myself was able to drive one of these tractors quite easily. International persisted with this system until nineteen eighty until they finally reverted to the H type gears again. Although they had tried to improved their original gearbox, farmers were too wary of the initial concept so there was always scepticism and an unacceptance about this system. This gear mechanism though, was the first time that tractor design introduced an element of style to the driver because it was now apparant that increased functionality alone was not enough to improve the overall standard of design.



*fig.5*  
*Ford ElectroShift transmission system, 1991*





Nowadays, transmissions are completely different due to the advent of electronics. With this technology, some gear systems have returned to a

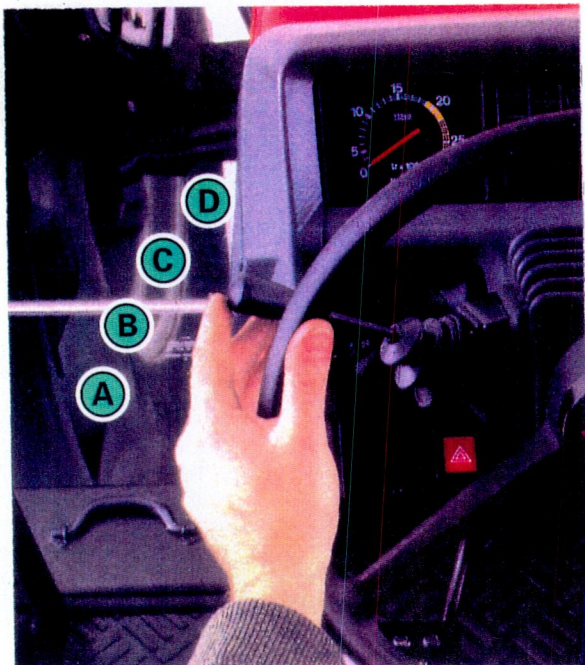


fig.6

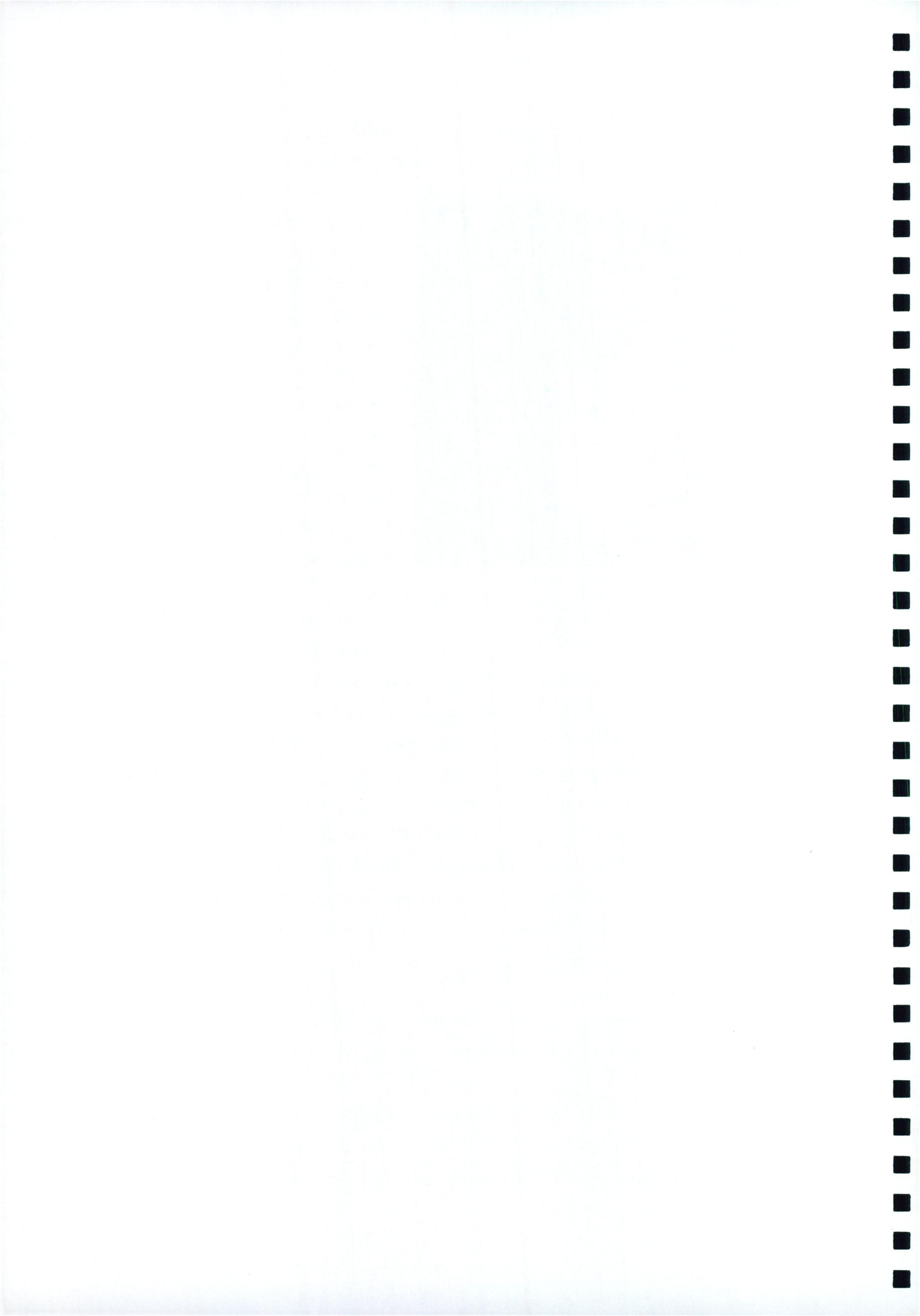
*Massey Ferguson's DynaShift transmission. It provides a 4 speed (ABCD) powershift change in each of the eight synchronised gears.*

straight line shift similar to that used by International twenty years previously like Ford have in their SLE Series in *fig. 5*. Massey Ferguson had always been considered to have the most reliable transmission systems available because they only use tried and tested units. However, due to using such systems, it usually meant that they are quite old and that ergonomics and styling were of a poor quality. On their most recent range of tractors launched in 1989, the 3600

Series, they introduced the latest in state of the art powershift transmissions in order to rid themselves of such a reputation completely. This system which they named 'Dynashift', provided a four speed powershift change in each of the eight forward gears along with the four reverse. This now provided the driver with thirty two forward speeds with fifteen of these in the field working range, so whatever the job, the correct speed is always available. This transmission system has been made possible due to the advancements made in electronics but without the help of styling and considerate design input, such a system could not have been used to its fullest capabilities like it has been.

This whole system is just another one of the great design improvements made by designers in order to increase productivity and efficiency.

The area of hydraulics has also been improved although the system used is still based on that designed by Harry Ferguson back in 1940. Engineering feats have been responsible for this improvement. The loads that can be lifted now





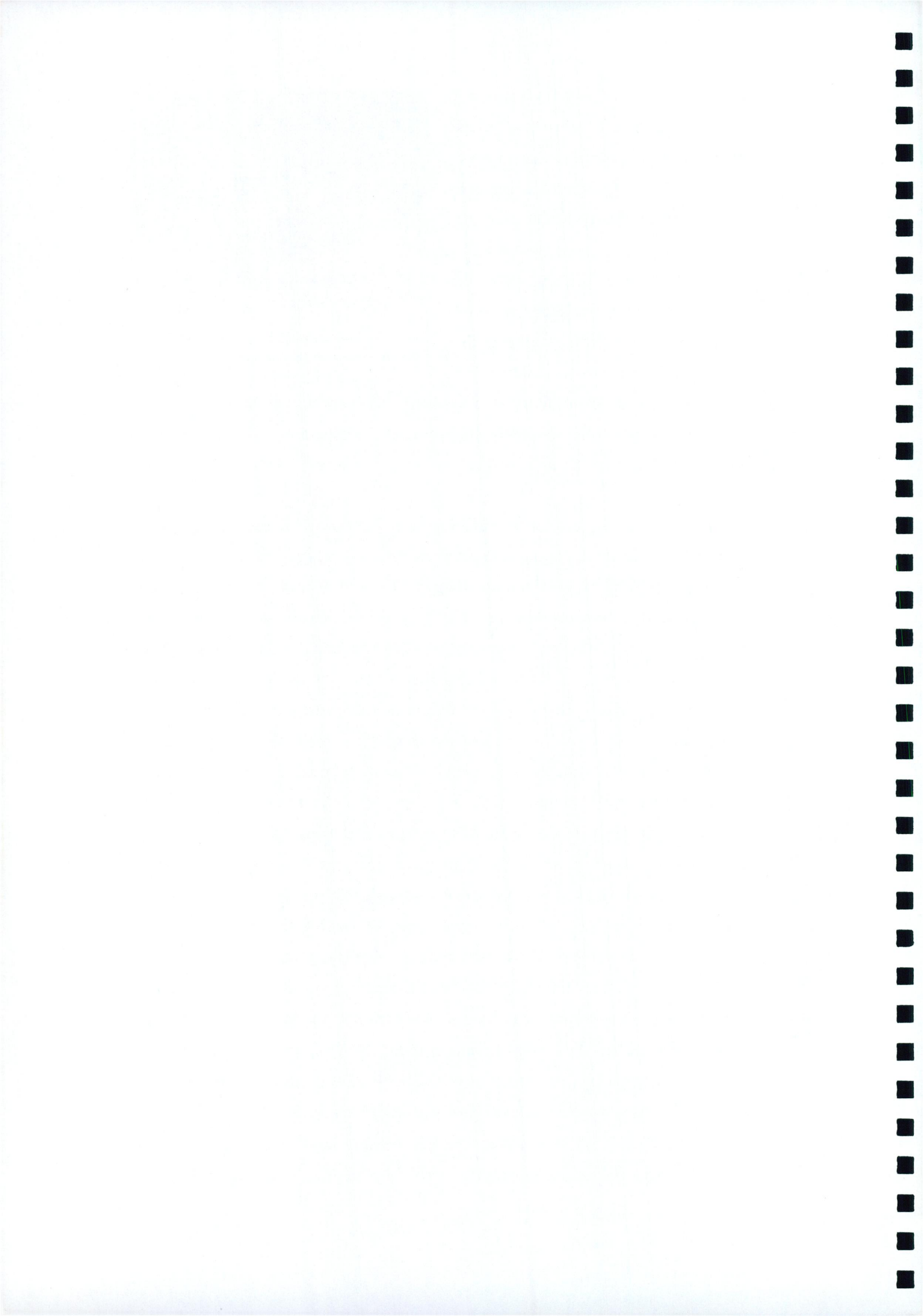
are twice that of twenty years ago. This has allowed tractors to utilise much larger implements than was ever possible. This of course has increased tractor productivity immensely and this can be easily seen by the falling number of tractor units sold every year even though the amount of work being done by tractors is greater than before. Even now, with the advancement of front hydraulic systems, tractors are capable of doing numerous tasks at once by being able to attach implements to both the front and the back of the tractor.



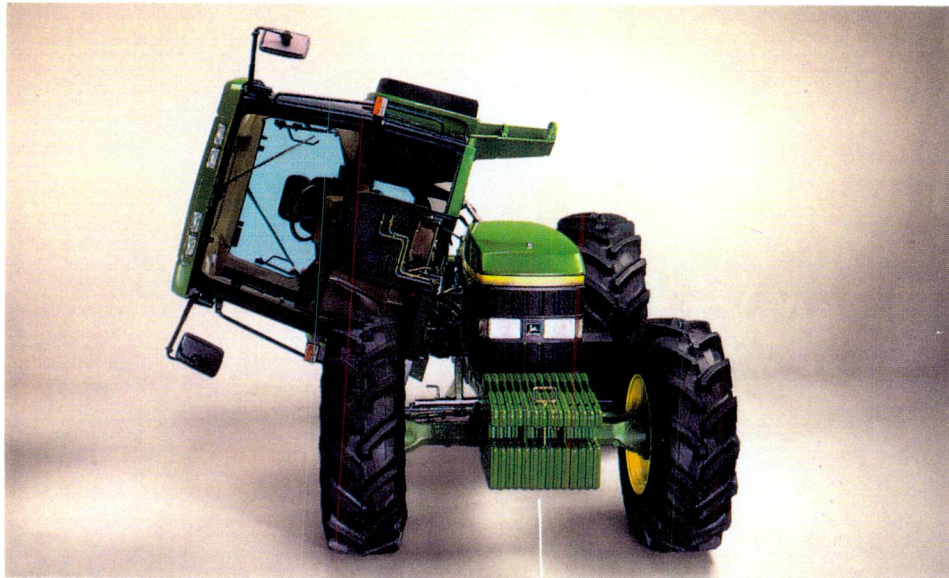
fig. 7

*An eight furrow reversible plough raised off the ground, a feat that was unknown 25 years ago.*

With all the leading tractor manufacturers, in terms of the technology used, there is little difference to choose between one and other. This has led rise to a whole new dimension in tractor design; user service accessibility. Years ago, this was never a serious consideration. Back then, tractors were assembled at the factory under the pretense that we lived in a Uthopian world where nothing went wrong. Of course, this is not the case and things are always going wrong. With a nineteen fifty's tractor, a fault with the hydraulics or the transmission or whatever, meant a dismantling of the main block of the tractor in order to get at the troubled area. In times when maximum output is required from your tractor, it is not a pretty sight to see it parked up, dismantled in the yard doing nothing besides gathering dust. Designers are now tackling this problem because they can see that this is one of the few areas in tractor design that has a serious influence over a persons decision on which tractor to buy. There are two types of tractor buyer; farmers and agricultural contractors. Curiously enough, farmers tend to buy the same make as their fathers bought before them. Because there is little to choose between any make of tractor, why not stay with the one you know and trust? In order to change this type of persons mind, designers are more concerned with user accessibility more than ever before because if a farmer can service a tractor, different to his, quicker and easier, it makes sense that this is the tractor for him. With contractors, this accessibility is of vital importance for in field repairs when necessary. Although they are two completely different





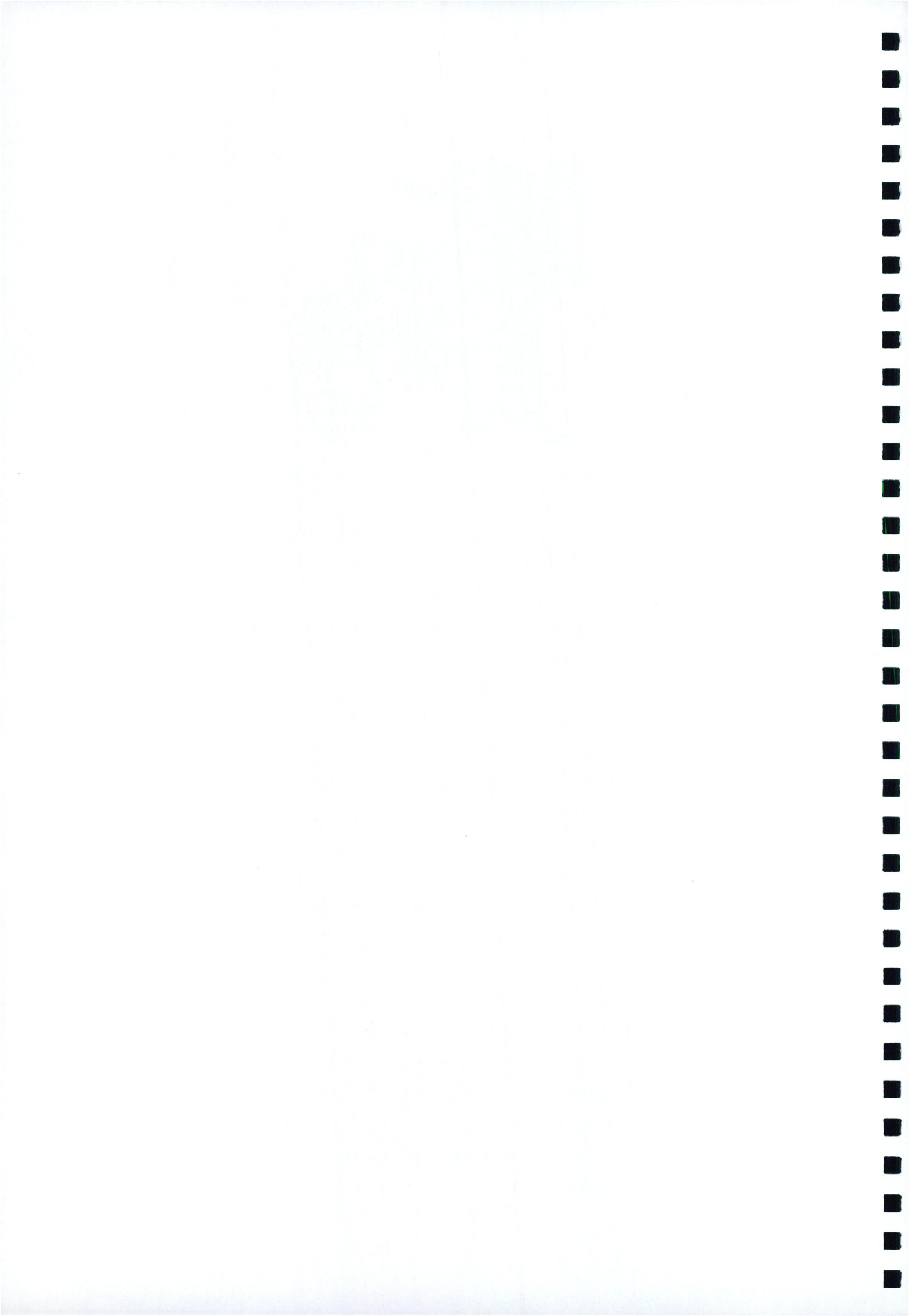


*fig.8*

*A 1992 John Deere with a tilting cab for easy accessibility to the transmission.*

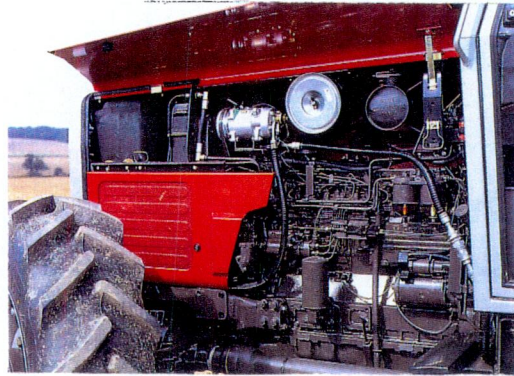
types of user, their prime objective is still the same; maximum productivity and efficiency. So, what are these improvements? John Deere are considered to be the producers of the most complete tractors available today. Just before Christmas last year, they launched a new range of tractors with a whole range of user access improvements. Two engine service doors - right side and left side - provide easy access to the engine, fuel filter, oil dipstick, filler cap and oil filter. In addition, the oil filter is placed vertically with the open end up. This allows the filter to be placed in and out without any mess involved. The cab can also be tilted on its side, just like a truck cab, for easy access to the transmission for major repairs. But it does not stop at these major focal points of the tractor, even the cabs air filters are taken into account. The replaceable paper air filters are located outside the cab. They are easily reached from the ground and are removable without tools. Each time the door is closed, the filters clean themselves and the dirt and dust is deposited in a convenient clean-out area.

These design improvements have helped to improve three things. The first two have been mentioned on numerous occasions already, productivity and efficiency. However, there is one area that has been left out almost completely so far and that is safety. With this new concern with user accessibility, tractors have become a much safer unit than ever before. Unfortunately, this change in standards only came after years of accidents with personal servicing of tractors. Before, should a fault arise, unskilled users were tackling the problems





themselves instead of contacting the dealer's expertise. Designers now accept that users will insist on doing most of their own repairs themselves so to prevent accidents happening, as little as possible is left to the user. In John Deere's new range, the service intervals have been extended for engine and transmission oil changes and components that used to require special attention, like the brakes and clutches, have been built with the lifetime concept that require no servicing at all. A new external design



*fig.9*

*Massey Ferguson 399 with a hinged hood to give easy access to engine, radiator and filters.*

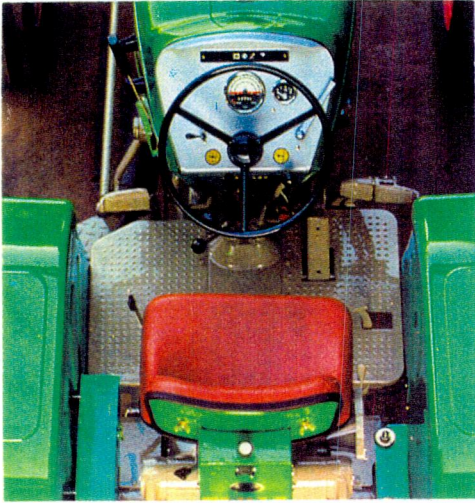
for the rockshaft and three-point hitch make these new tractors easier to service. Just as important as this, all the systems stay connected: the steering and brakes, hydraulics, air conditioner, heater, gear-shifting, SVC controls (selective control valves) and wiring harnesses, all to make sure that no time is wasted disconnecting and reconnecting. There is also no more bleeding the brakes, recharging the AC circuit and with the wiring harness, no chance of introducing a faulty connection. Many other repair jobs, like the drive-shaft, fuel pump, main hydraulic pump and air conditioner components, can be done without tilting the cab because access is through service hatches on the cab floor. All these improvements are only made possible due to the designers blending of styling and functionability. It is the perfect combination of these two that makes tractor design so complete. (John Deere advertisement brochure, 1992)





## Chapter Two: Cab Design

Before nineteen fifty, around ninety five per cent of the tractor's functions were located outside the 'cab' area. (Design magazine, December 1990, p.39.)



*fig. 10*  
*Driver's platform on a Deutz 62 06*  
*1971 model*

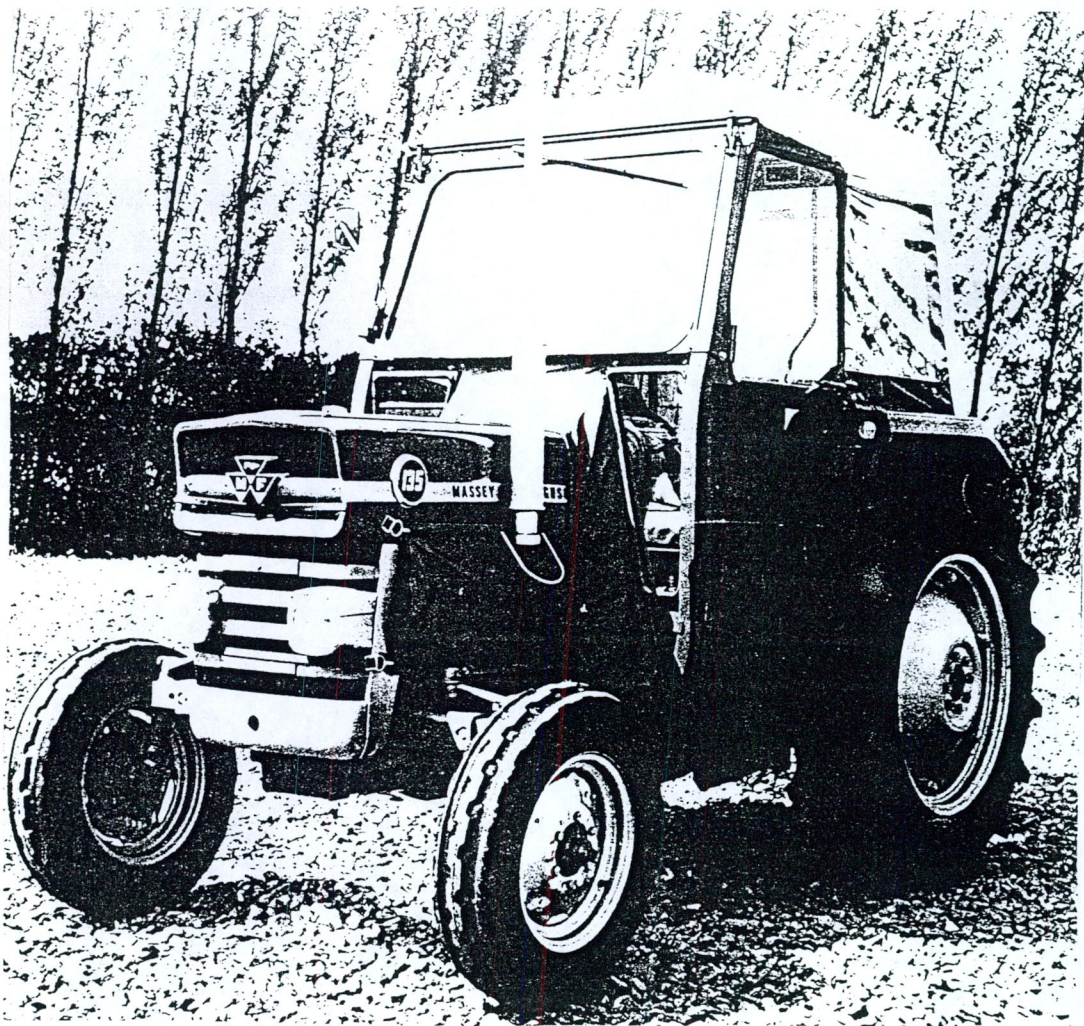
This situation has changed drastically over the last thirty years and even moreso in the last ten. When, in the sixty's, more functions were being operated from the driver's area, more consideration had to be given to the layout of the this area. Legislation was also being passed that tractors would have to incorporate safety frames in order to protect the driver from injury if the tractor was to overturn. This initiated a whole new area of tractor design that was never before considered necessary.

As with any new area of design, the initial results were of poor quality because there were no previous examples to learn from and improve on. Early cab design was very primitive by present day standards. Again, because this was a totally new design area, each tractor designer had his own ideas on how cabs should evolve. Because cabs were introduced as a safety feature, ergonomics or styling, initially, were never a consideration in their design. The first cabs were mainly designed by engineers who were given a brief of what safety standard the cab should meet. They then set about constructing a frame which would inclose the driver from the outside. When this frame was finished, it was then the job of the designer to complete the cab by designing the doors and window sections and setting out the controls in a way that was easy for the driver to operate. The proof that cab design was not considered a serious sales booster can be seen in the advertisement brochures for tractors of this period. Manufacturers were still believing in the concept that shear power was the only commodity that the buyers were looking for. It was only when the tractors started to get bigger and the work more intense that farmers and contractors began to inform the manufacturers of their driving discomforts.



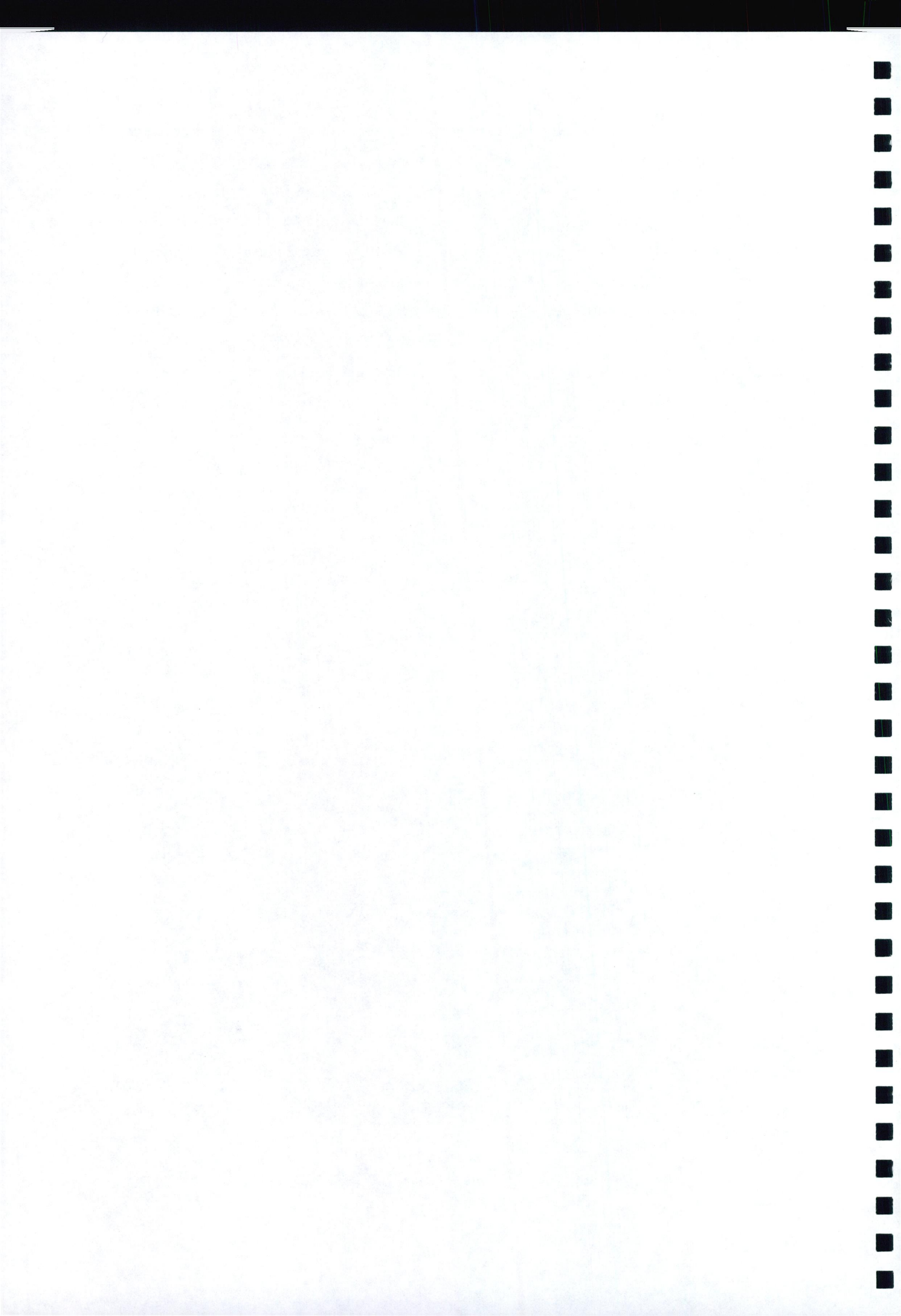


Massey Ferguson, who were renowned for making tractors with excellent technical performance figures, were just one example of a company who were designing cabs that were, plain and simply, useless. The idea of designing the cab as a whole never seemed to enter their minds. Instead, the engineer created the frame and then, this was passed onto the designer to 'disguise' it and to make the driving environment as comfortable as possible. The solution that they came up with was to insulate the driver by using a flexible cladding material on the doors and roof. This resulted in the classic design flaw which was that on paper, it appeared a viable solution, but when put to the test in our non-utopian world, it simply collapsed. One would have been hard pressed to find a Massey Ferguson tractor only two years after it had been purchased with its doors still in tact. The canvas material just could not cope with every day wear and tear on the farm so the end result was that users were actually resorting to removing the doors in order to achieve greater comfort.



*fig. 11*  
*Massey Ferguson 135 with an early cab design using flexible cladding*





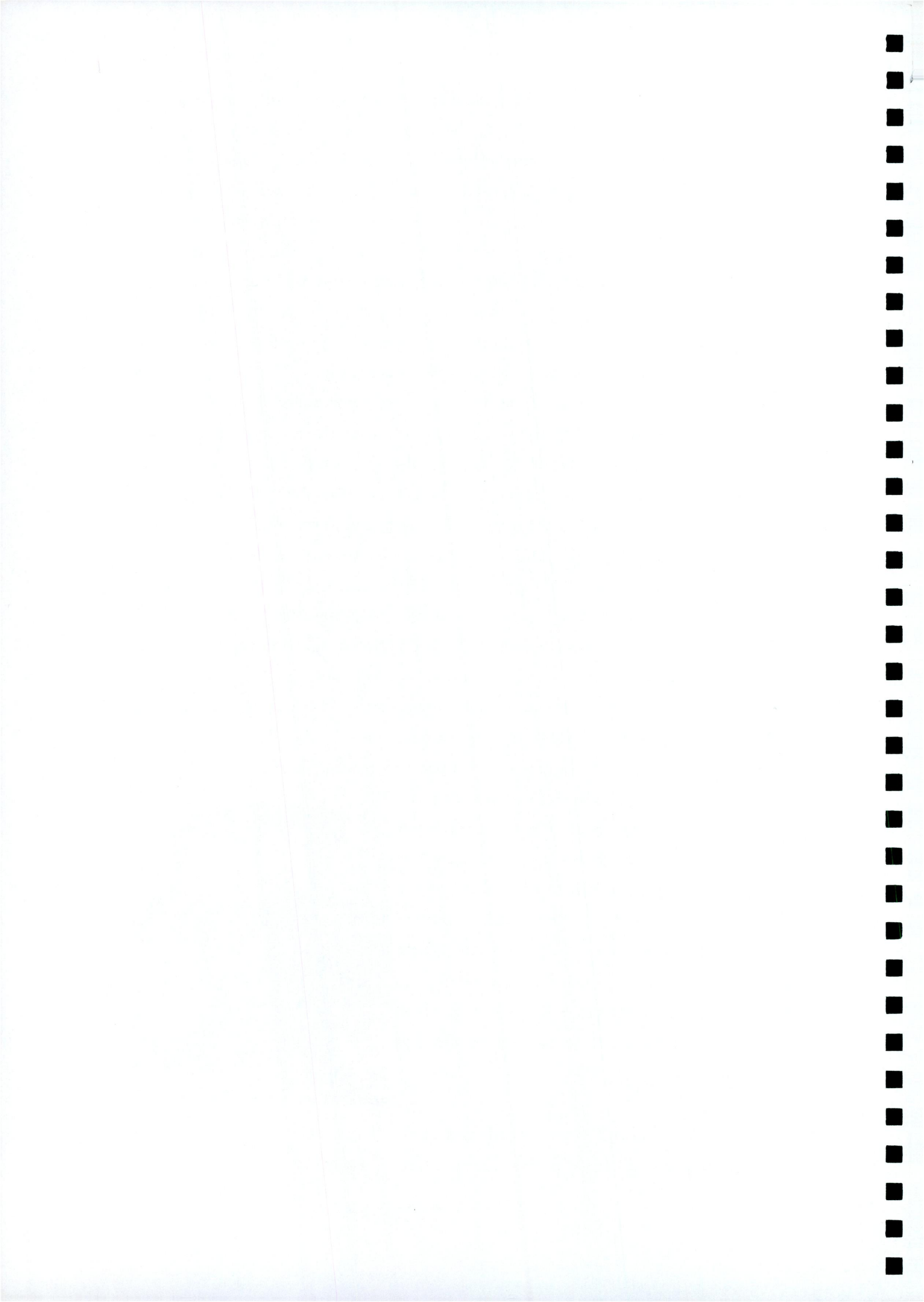
That scenario is like something more suited to a comic book, 'we design the doors to create a more comfortable working environment, but in order to be more comfortable, we must remove these doors first'. Cabs were also advertised as being "sound insulated". (Massey Ferguson advertising brochure, 1974.) Maybe that is why in most of the brochures, the tractor operator is wearing ear-muffs. Maybe this is what they meant by "sound insulation". In fact, if one was looking for protection against engine noise, ear-muffs were the only solution because you certainly were not going to get it from the "sound insulated flexible cladding". Sound levels were only one of a whole host of problems to be found with these early creations. There was even less comfort provided for the driver because the seat was bolted directly onto the transmission block. The driver was now one with the tractor because every bump and jolt that the tractor felt was also shared by him. Even the basic ergonomic layout of the driver's area was of poor standard. The worst of all was the positioning of the gear stick which was to be found between the driver's legs. With each gear change, the driver would have to lean forward a little in order to reach the gear levers. Twelve hours a day of doing this the whole time soon led to a sore back which would cause less productivity and efficiency, the two basic commodities that tractor design is trying to increase. This gear stick positioning was also a safety hazard. In 1979, a one Mr Vincent Evans was killed as he was leaving the cab. He was believed to have brushed against the main gear lever and with the tractor layout the way it was, the tractor was able to shift into gear without the clutch being operated. The result was a jolt that knocked Mr Evans to the ground where he was then crushed by the wheel of the tractor which was by then moving at 1mph to 2mph. He died shortly afterwards. There was an inquiry and David Brown, the company responsible, were told to recall similar models and to re-position the gear lever.



In 1981, John Deere introduced their 'Sound Gard II' cab. This was the first time

*fig.12 right*  
*John Deere 2140XE equipped with a*  
*Sound Gard II cab*







*fig. 13*  
*Driver's view from a Sound Gard II cab*

that the user comfort concept was tackled seriously. It was also revolutionary as far as aesthetics were concerned due to the rather bizarre semi-circular windscreen. The windscreen was like this for two reasons: one, to deflect sound away from the driver and two, to deflect glare from the sun. The recorded sound level inside the cab with the engine at full revs was 78dB. This made the John Deere the quietest tractor available at the time. They also revolutionised ergonomics. For once, all the controls were within one single sweep of the hand or slight movement of the feet. The controls themselves were shaped and colour coded to make them easier to identify. The driver could now concentrate better on his work because there was no more fumbling around looking for a particular lever. At night, an amber light situated in the roof of the cab lit up the console to make identification even easier. All these perks did come with a price that made John Deere tractors the most expensive models on the UK market. This however did not deter people from buying them because within two years of their launch, John Deere tractor sales increased over 30% to make them the third biggest seller in the UK. These figures showed that farmers and contractors alike, very much valued their comfort and were prepared to pay the extra cost for it.

In John Deere's latest range of tractors, many of the fore mentioned features

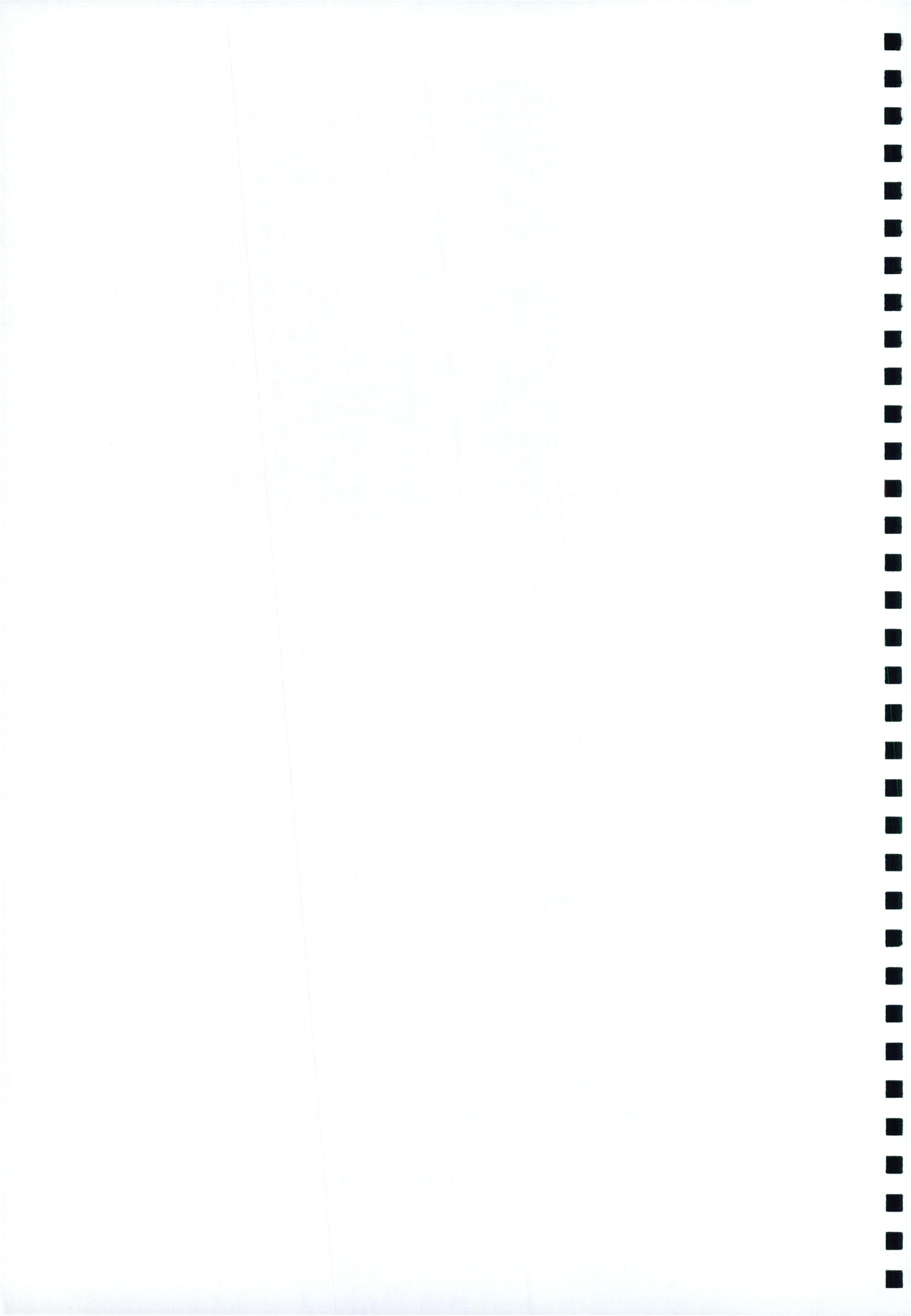






fig. 14

*A digital display that gives precise information on travel speed, engine and PTO rpm which is ideal for spraying and spreading applications.*

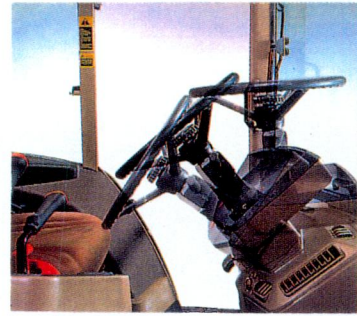


fig. 15

*As the tilting and telescopic steering column is adjusted, the instrument pod follows for perfect visibility.*



fig. 16

*Operator's seat features adjustments for size, weight, backrest, horizontal suspension and swivel control.*

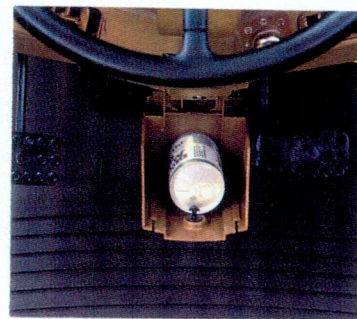


fig. 17

*Drinks stay cool in this refrigerated compartment.*



fig. 18

*A large removable roof hatch lets in plenty of fresh air and is available with front or rear hinges.*



fig. 19

*A removable, insulated lunchbox has room for at least two, one-litre bottles. It stores conveniently behind the seat.*

*Features to be found on a new John Deere*

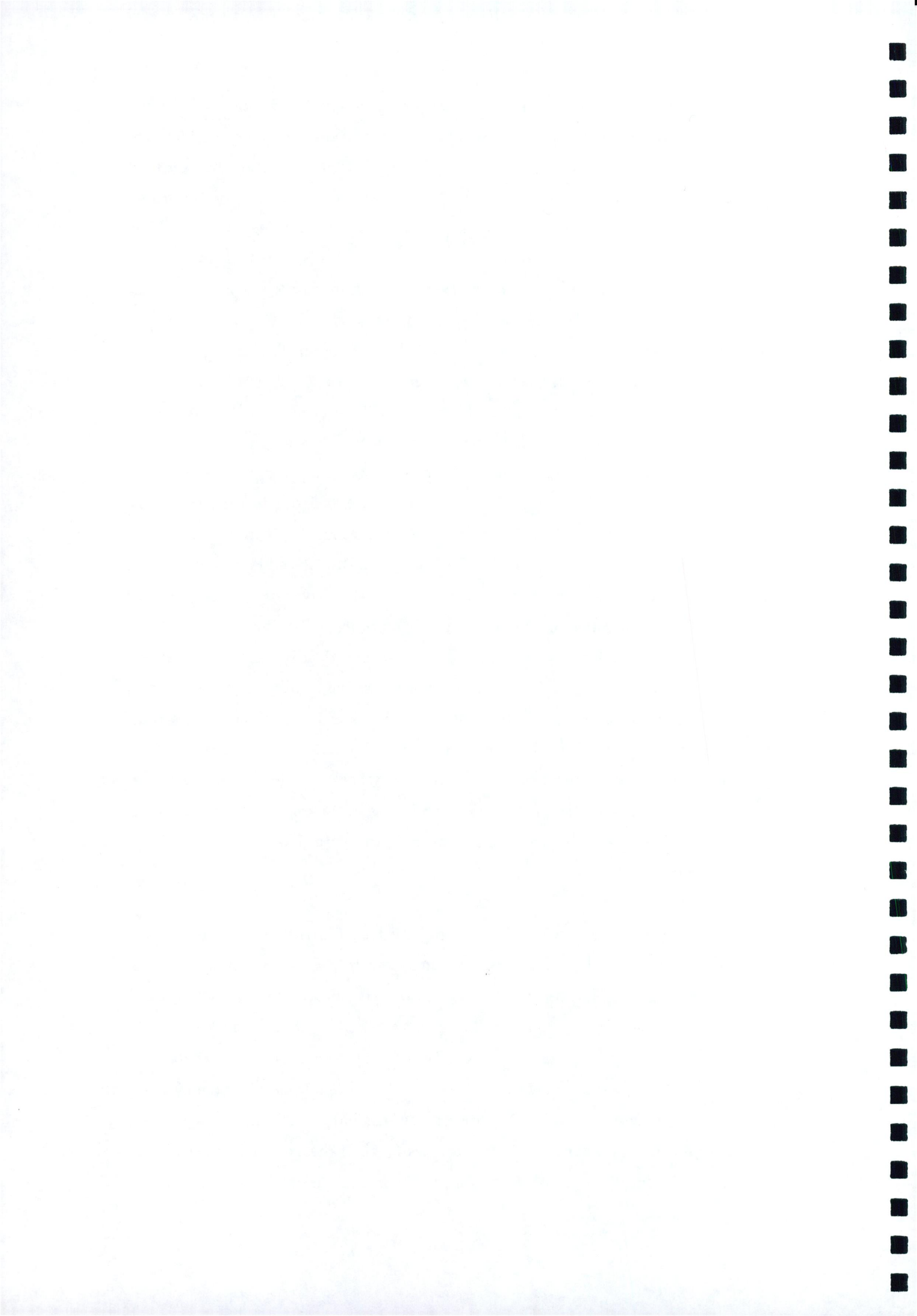




have been upgraded to increase the driver's productivity. Of all the changes made to the cab, the most notable is the absence of the circular cab which has been replaced by a more conventional square cab. The reason for this was that other manufacturers had started to achieve similar and even better noise figures than John Deere had with conventional square shaped cabs. The advantage that the square shape had over the round was that it could use two doors for access whereas the round could only house one. Having only one door was more of an annoyance than anything else for the user who was mounting and dismounting the tractor regularly. Another disadvantage was the shape of the glass. If the glass broke, a new pane could not be obtained from the local glazer due to its shape. Instead, a new pane would have to be imported from the manufacturers in Germany which took time and money. All other tractor manufacturers fit flat glass to their machines so as to avoid trouble like this. Other features of a present day cab design are the operators seat which can be make adjustments for size, weight, backrest, horizontal suspension and swivel control. The use of digital displays which are clearer to see have reduced the amount of necessary time the driver has to take his eyes off his work in order in order to read the significant data presented to him. There has been a lot more care given to the smaller details also that help make a more comfortable work environment for the driver like sun-roofs, tinted glass, CD players, fitted refrigerated lunch boxes and drinks coolers, telescopic steering wheels, in fact, there are too many to mention but it is only when one spends a long period of time behind the wheel of a new design, like the Case International 'Magnum' overleaf, and has had the experience of driving a tractor from twenty years ago can these new improvements be fully appreciated.

According to Ray Innes, whose company has, for the last twenty years, designed many of the cabs in use around the world,"the cabs of most tractors and earth moving machinery are little more than an evolution of sitting on a horse". (Design, p.39, 1990.) Where he got such an idea amazes me. Ray Innes must be unaware as to the physical appearance of a horse or the functions that come as standard on certain breeds. It leads to the inevitable question of what kind of quality are his designs? How could any person make such an accusation about a design that has reached the goal that it set out to achieve in the first place? It is not too often that designers are capable of





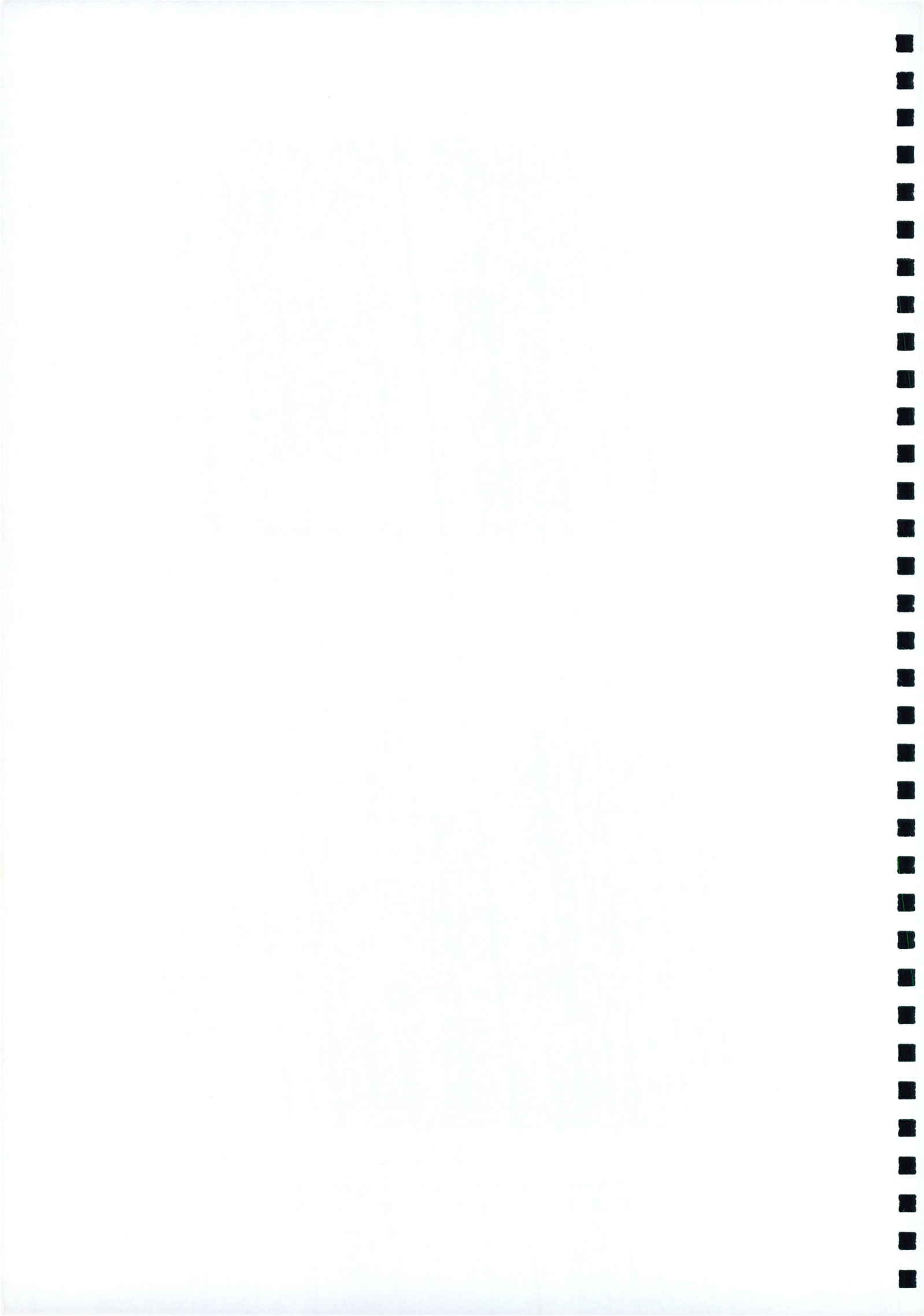


*fig.20*



*fig.21*

*Both fig.20 and fig.21 show us the high standard in tractor cab design and the excellent blending of form and function. The two above examples are of Case International's top of the range 'Magnum' tractor.*





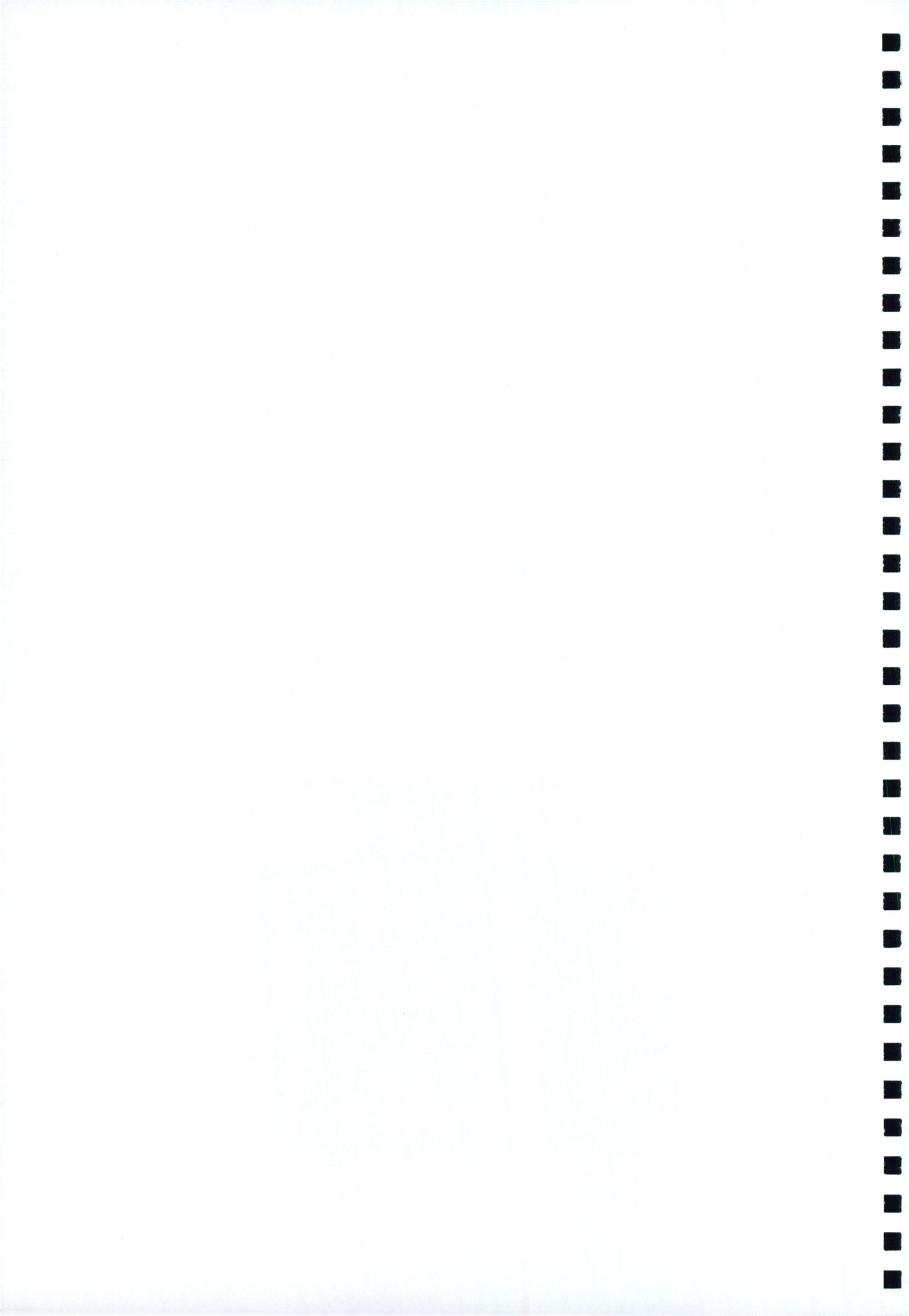
completely satisfying a brief but with the area of tractor cab design, designers have come very close (see *fig.20* and *fig.21*). Tractor ergonomics are as good as those of cars for instance. Seat adjustment in cars can at times be a troublesome and an annoying experience but due to the simple design approach with tractor cabs, there are no such problems. Even the area of visibility is of a much higher standard in tractors than it is with cars. Everyone has had the experience when parking a car of not knowing when you were about to nudge the car in front or behind you. There is no such problem with tractors because the driver can see every part of the machine from his seat.

However, there is one area of cab design that is undergoing continuous improvement and that is the insulation method used to drown out bumps and knocks. All cabs are presently mounted on rubber blocks but research work carried out by Renault Agriculture shows that these kind of cabs can present a health hazard after only two hours in the seat with some of the rougher applications. Before, cabs were bolted directly onto the tractor block which gave the driver no cushioning from the rugged ground. Now, rubber insulation is positioned between the main block and the cab which has helped to greatly reduce the vibration and sound levels received by the driver. By comparison, Renault's unique TZ hydrostable sprung mounted cab can reduce vibration severity by up to an extra 35 per cent, doubling the safe working time.



*fig.22*

*A view of Renault's TZ cab which allows us to see the spring suspension system.*





Introduced by Renault Agriculture four years ago, the TZ cab was designed specifically to improve operator comfort and to help alleviate back problems by reducing levels of stress not only in the vertical plane (which a conventional seat does to a certain extent) but also in the fore and aft plane. The TZ hydrostable cab system was designed with the aid of the engineers from Renault's Truck Division, who have considerable experience in the



*fig.23*

*A Renault 14554 at work with a TZ cab which can reduce vibration severity by up to thirty five per cent.*

design of similar systems for truck cabs. The tests were carried out according to major international guidelines for measuring the degree of stress exerted on the human body. In the evaluation of the resulting vibration levels, the health hazard limit in the standard type cab is reached after three hours of operation but with the TZ

cab, this limit is not reached for six hours. The use of a sprung cab effectively enables the operator to achieve nearly twice the output before his health is affected. This cab system is available on only a few models in the Renault range due to the extra considerable cost of it but for the driver who has the extra cash and likes his comfort, then one of the Renault TZ range of tractors should be his priority.

Although tractor cabs still have not reached state of the art stage, they have gone as far as is possible for the moment. Sure it could be said why don't all tractor manufacturers fit similar types of cab insulation systems as Renault? Well the simple answer is cost. In tractor design moreso than in any other area of transport design is the cost of the final product of severe importance. Any tractor designer is capable of creating a state of the art design but the price tag that would accompany such a design would make it totally impractical. The profits to be made from farming or contracting do not justify such an investment so the standard of cab design at present is of the highest possible quality.





### Chapter Three: The Intelligent Tractor

Back in 1987, Massey Ferguson launched a new range of tractors that they hoped would put them back at the top of the tractor market in Britain. A towny's bucolic image of a tractor, all red and bright and driven by a rustic



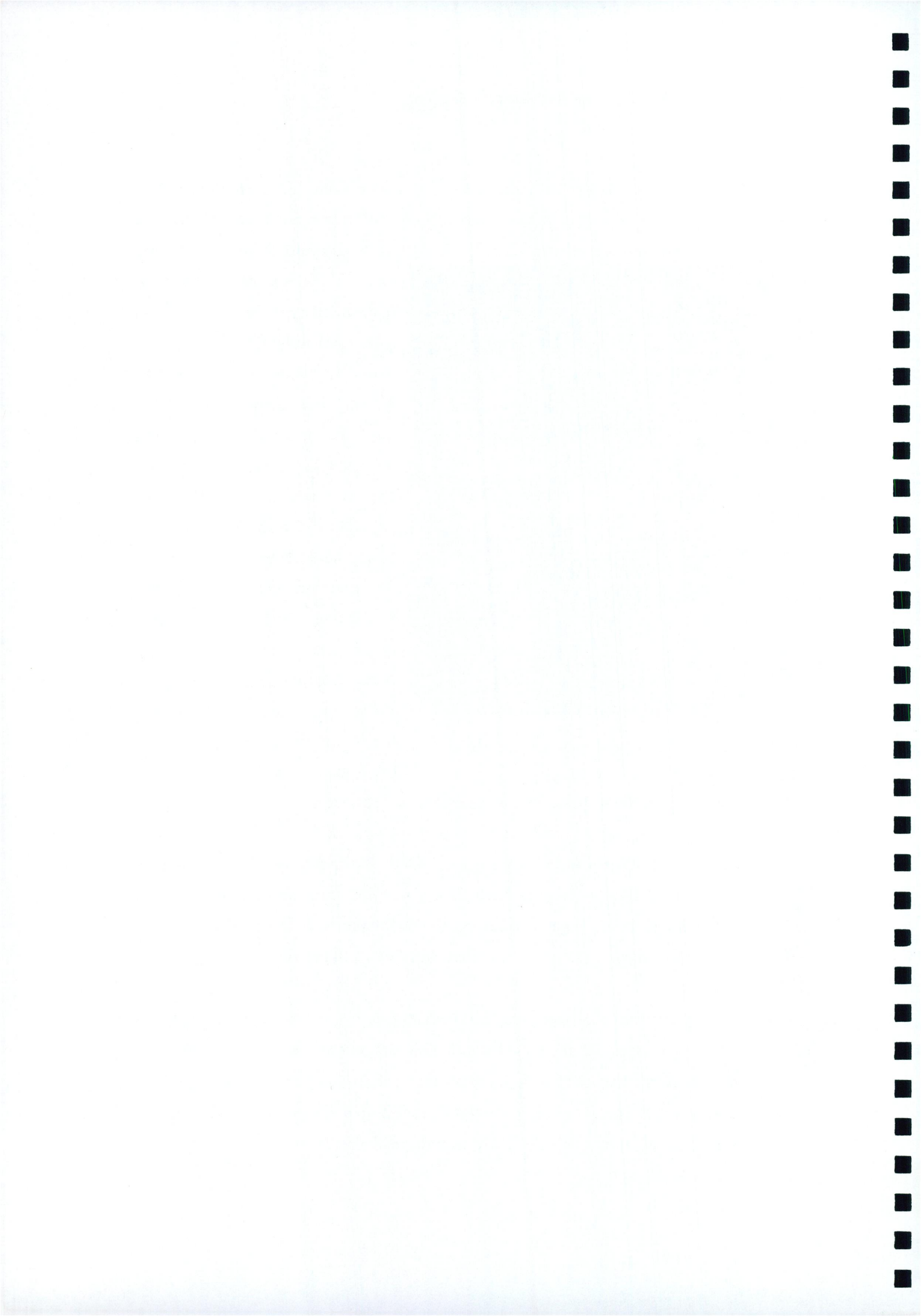
*fig.24*

*A massey Ferguson 3060, the world's first intelligent tractor.*

cheerfully exposed to the invigorating elements on his backless tin seat, is based on a design that went out in the 40s. As we now know, tractors are more likely to come equipped with CD players in air conditioned cabs with fully adjustable ergonomic seats. In 1983, Massey Ferguson carried out a survey among users in the UK and France. Farmers responded that they wanted reduced cab noise, better gear-shifts, improved brakes, larger fuel tanks and more attention to ergonomics and the driver's

environment. From these requirements, it can be seen that they are all related to two things; higher productivity and efficiency. In 1985, Massey Ferguson introduced an upgraded version of their 2000 Series tractors which incorporated all these requirements. But it was not until the launch in 1986 of a completely new range of tractors, the 3000 series, that the final touches were added to the strategy with the world's first thinking tractor.

The big difference between the 3000 Series tractors and their forebearers was in the way in which they used computers and micro-electronics to improve the productivity. Brute horsepower was no longer the sole buying consideration, today's profit oriented farmer wants a machine to do the job more quickly, more cost effectively and in greater comfort.

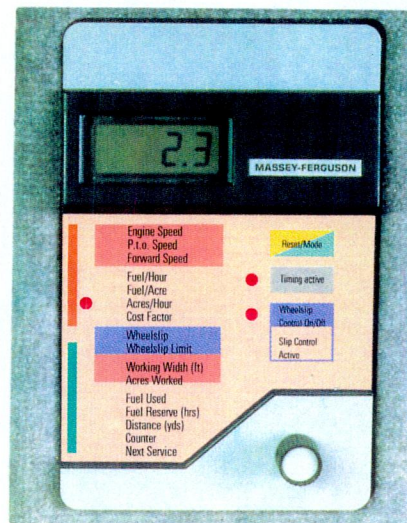




This all-new range of machines launched by Massey Ferguson

*fig.25  
The Datatronic panel,  
with one control  
for 14 functions.*

could 'think' out the most cost effective way of operating and so save time and money for farmers under pressure from increasing costs. M-F had invested almost £40 million to produce the new 3000 Series tractor which comprised of only five models.



Two small onboard computers controlled the amount of wheel spin and looked after nearly a dozen other functions of the tractor that would normally be part of the driver's decision making process. They also provided him with a mass of information on which he could base his driving and methods of operation in order to achieve optimum performance. The driver was then freed from having to remember and carry out many routine actions by a small micro-chip packed box fitted under the tractor. On 4-wheel drive tractors, for instance, it automatically disengaged the drive to the front wheels when the tractor had reached more than 14 km/h (8.7 mph) to avoid unnecessary tyre wear and fuel consumption when travelling on roads. However, it would automatically engage 4-wheel drive when the brakes are applied at speeds greater than 14 km/h for better braking and control, especially on slippery surfaces. Drive was also to all four wheels whenever the driver engaged the tractor's rear wheel differential lock. The same unit also was used to protect the tractor's transmission from accidental damage by preventing changing from one gear range to a lower one if the speed of the tractor was too great for the gears to be properly engaged. It also controlled the power-take-off engagement so that the build up of drive to the implement was always totally smooth and irrespective of the implement's inertia. In all these and other operations, any misjudgements the operator might have made are totally eliminated, and the only evidence of the mini-computer's existence is the automatic operation of the functions concerned.

The second computer fed the operator information about the tractor's performance so that he could make adjustments in the way it is being driven to maximise output and minimise costs. Throughout every work session, he





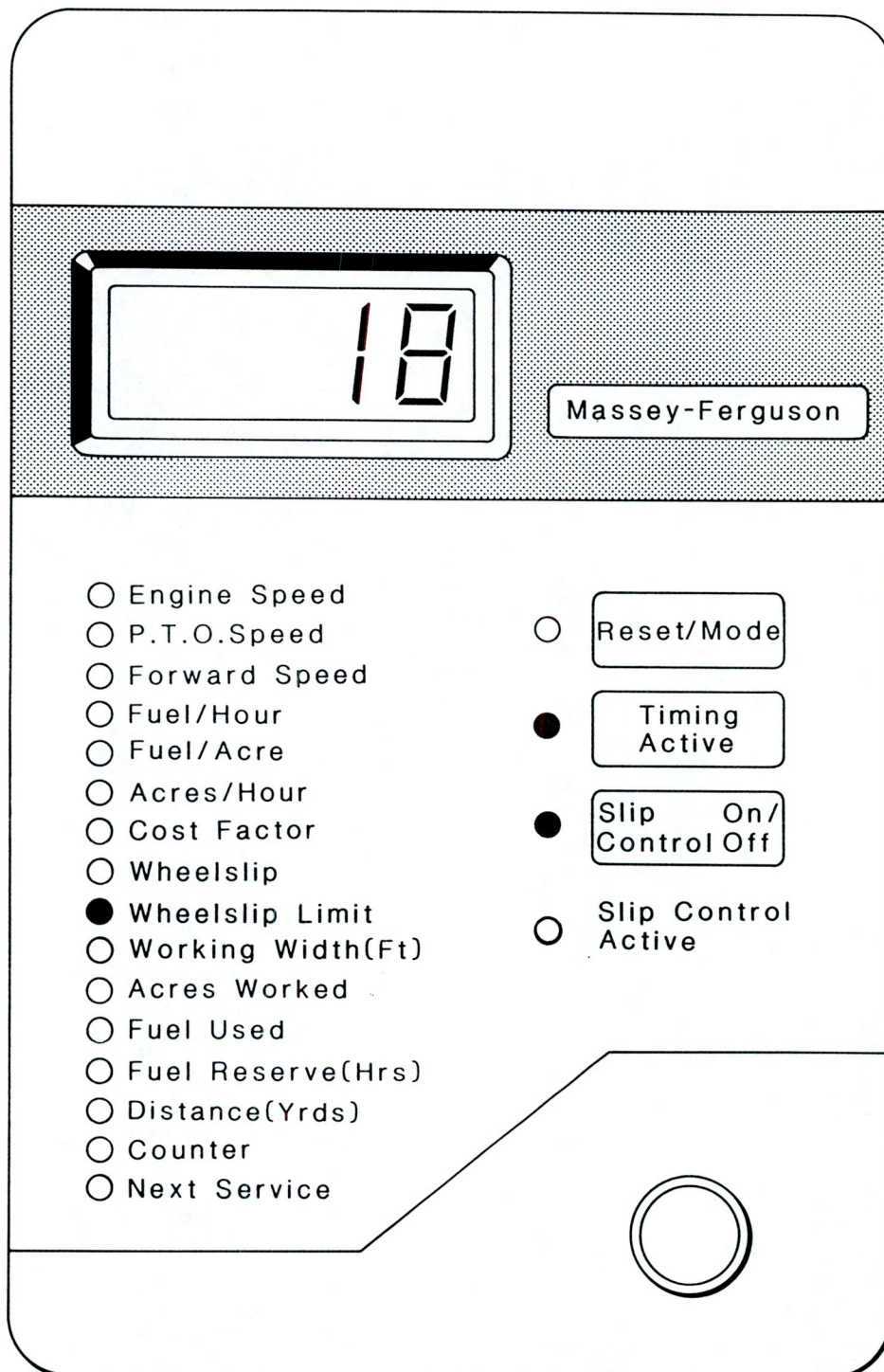
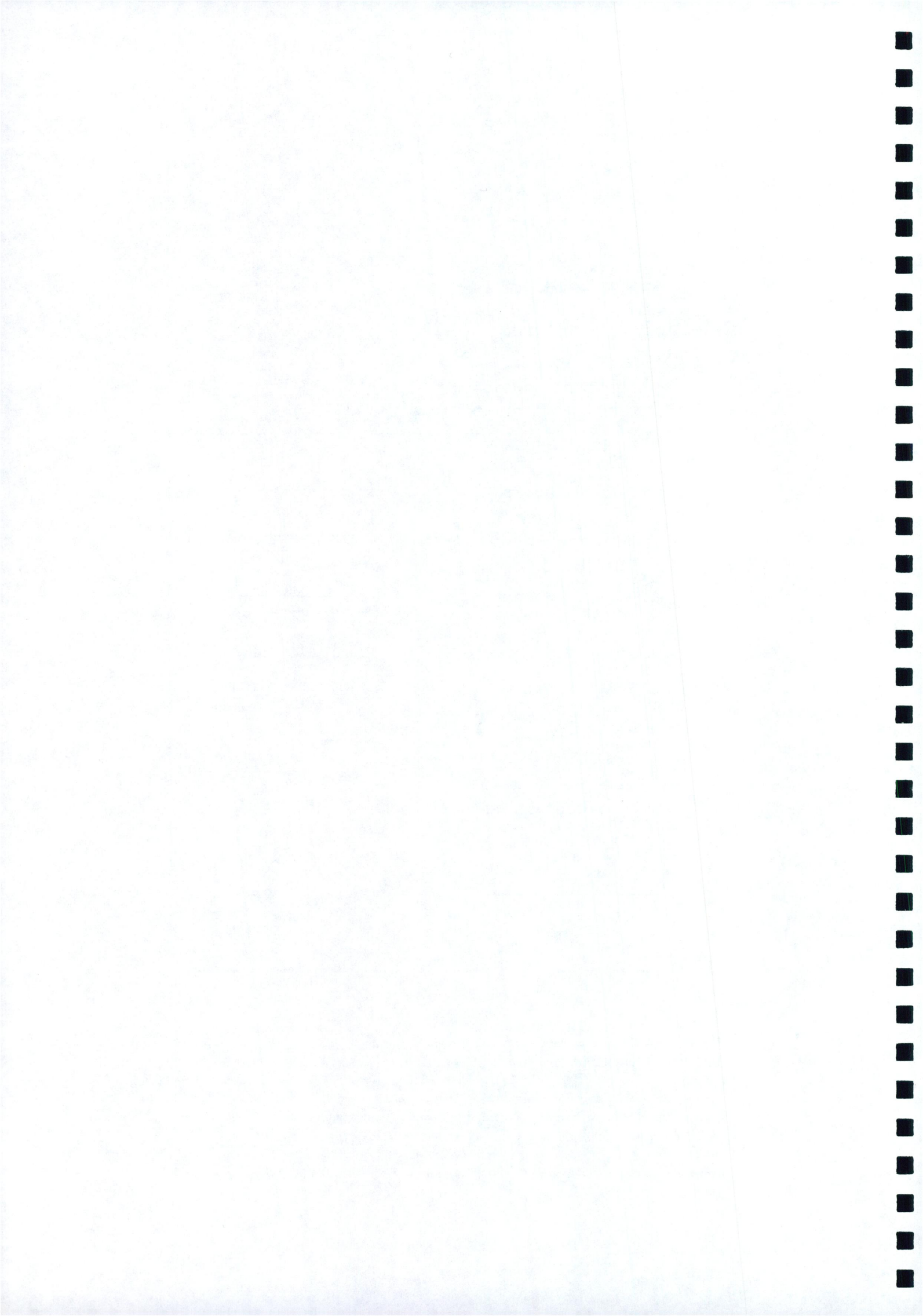


fig.26

The 'Datatronic' information console in the cab of Massey Ferguson's 'intelligent' 3000 Series tractors. The range of information that can be displayed is listed on the left, and the subject chosen for display is identified by an indicator light. Selection is made by rotating the knob (bottom right). In this example, the information being displayed is the wheelslip limit that has been pre-set by the operator. The "Slip Control Active" light on the right will come on to show that the automatic system is working whenever it cuts-in to reduce wheelslip if the pre-set limit is exceeded. Also on the right are the "Reset/Mode" touch sensor; a "Timing Active" touch sensor, which when pressed, will monitor, for example, area worked and fuel used; and the "Slip Control" touch sensor for switching on or off the automatic wheelslip control function.





could be provided with a continuous indication of what it was costing to do a job based on servicing costs, fuel costs, depreciation costs and wages costs. The information was shown on a digital readout. Any change the driver made in the way the tractor was being operated was measured and calculated by the computer, and he could see immediately whether it was increasing or decreasing the cost of the work. At any time, the operator could get a spot check in the tractor's work rate and fuel consumption. If he decided to optimise one or the other of these, or even the total running cost, he could immediately compare on the digital display the improvement achieved, as well as the effect on each of the others. These new tractors made true precision farming a reality at a time when many farmers are looking for help in controlling their input costs and becoming much more precise in the measurement and control of their enterprises. In these respects, those new tractors were revolutionary and would allow farmers to measure and control very precisely a part of their operation that until now they have had to leave to guesswork or 'steam gauge' methods.

'Autotronic' was the name given to models equipped with the automated controls package as standard. 'Datatronic' models shared the same automated systems but with additional features that provided the same automatic wheel slip control and performance information.

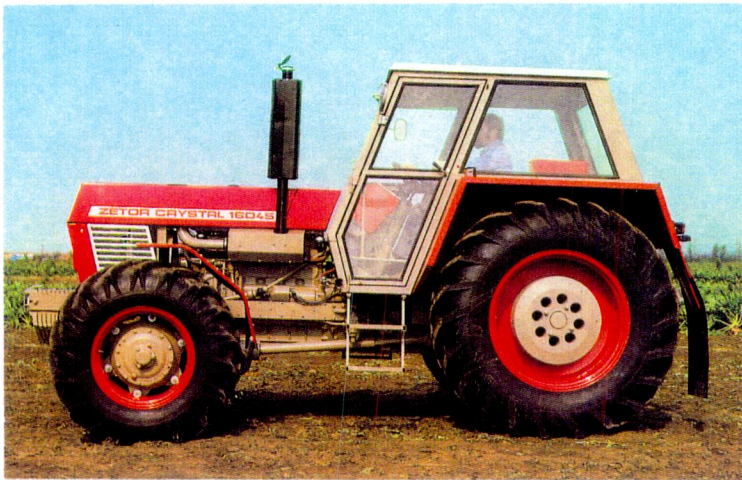
The introduction of onboard computers has been the last major step in the history of tractor design. All the leading tractor manufacturers now make models that come equipped with systems similar to those that Massey Ferguson introduced almost seven years ago. This leap in tractor design finally released modern tractors from the image that had been associated with them for so many years. Tractors would no longer be regarded as the farmer's favourite toy nor could they be considered to be mechanically simple iron workhorses. No, from this point onwards, tractor design would begin to earn respect for its excellence, a respect that was a long time overdue.





## Chapter Four: Eastern Block Design

In Ireland at present, the two main Eastern block built make of tractors are Zetor, who are manufactured in what was formerly known as Czechoslovakia and Ursus, who are Polish made. There have been many other eastern tractors available in Ireland before now but nearly all have been taken off the market due to their poor standard of design and performance. So what have Zetor and Ursus got that their predecessors lacked and why is it that Zetors have been Ireland's best selling tractor for the past seven years?

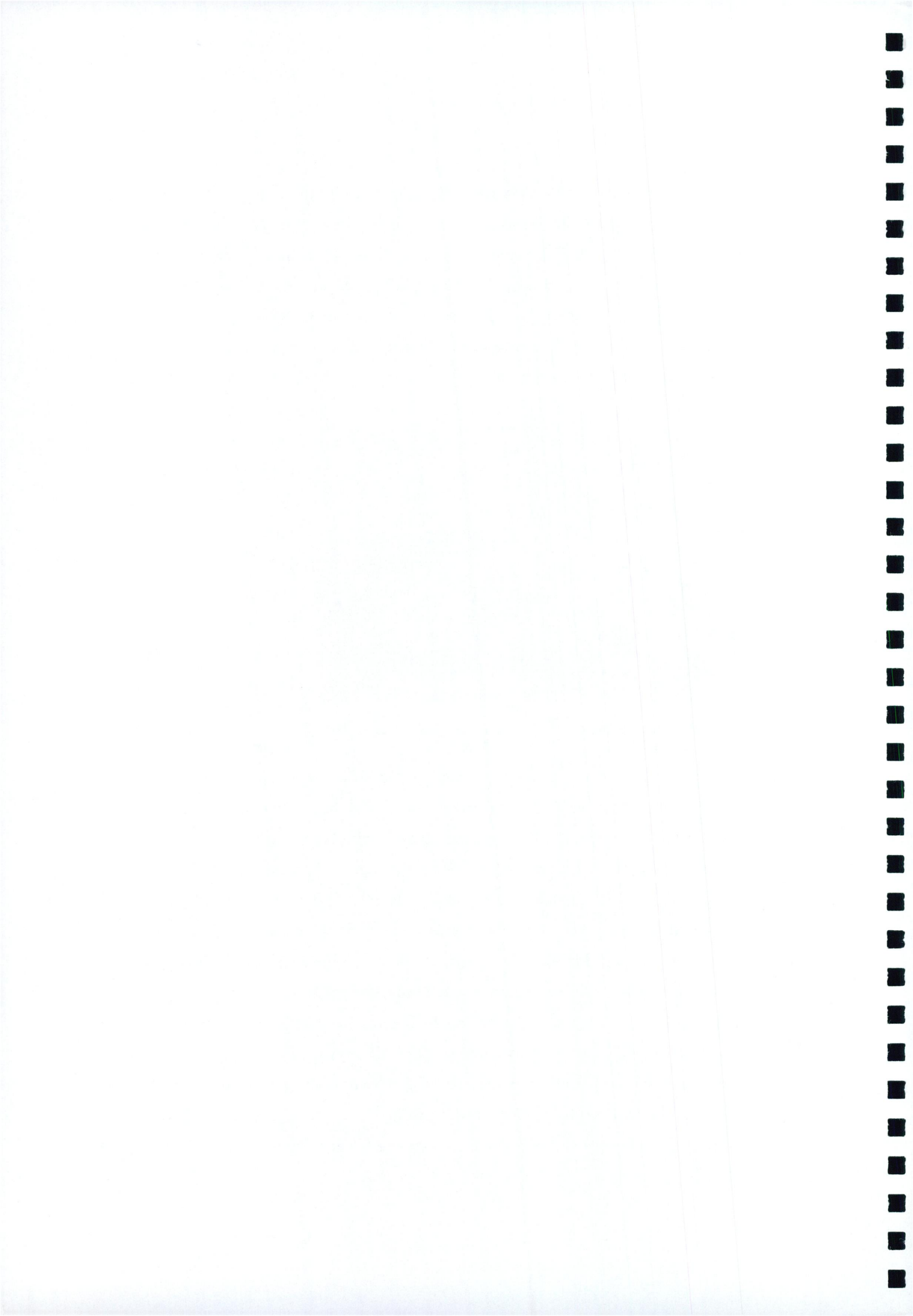


*fig.27*

*A Zetor Crystal 16045 4WD. Production of this model ended in 1985.*

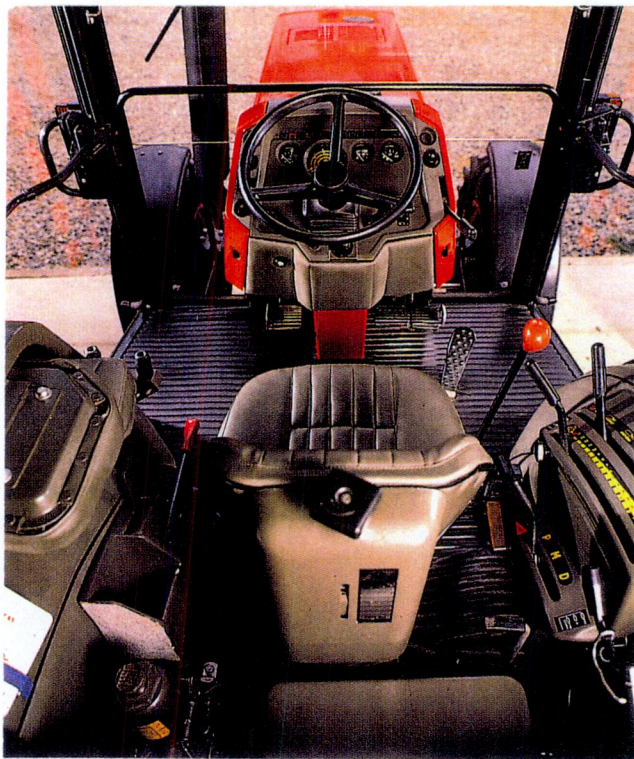
Eastern tractor design started just over eighty years ago. Since then, there have been many changes in its industry except for one thing, their approach to design. The one common feature of eastern

tractors is their very simple approach to solving the farmer's needs. Any eastern design that we are familiar with has always had a reputation for being cold and unimaginative. The philosophy is almost to solve the problem systematically with no flair or individualism at all coming through in the design. With their tractors, form most definitely follows function. There is nothing at all high-tech about their cabs, in fact, they have changed very little in the last twenty five years. It is this simplicity in approach that both Zetor and Ursus use to their advantage when marketing their tractors. They are offering the buyer a no nonsense, no frills attached machine that they say is capable of equalling the performance figures of any western tractor. A 100hp Ursus would come with a price tag of just over £20,000 while a Massey Ferguson in the same power range would cost over £25,000. This is a substantial difference so how is one to choose between the two?





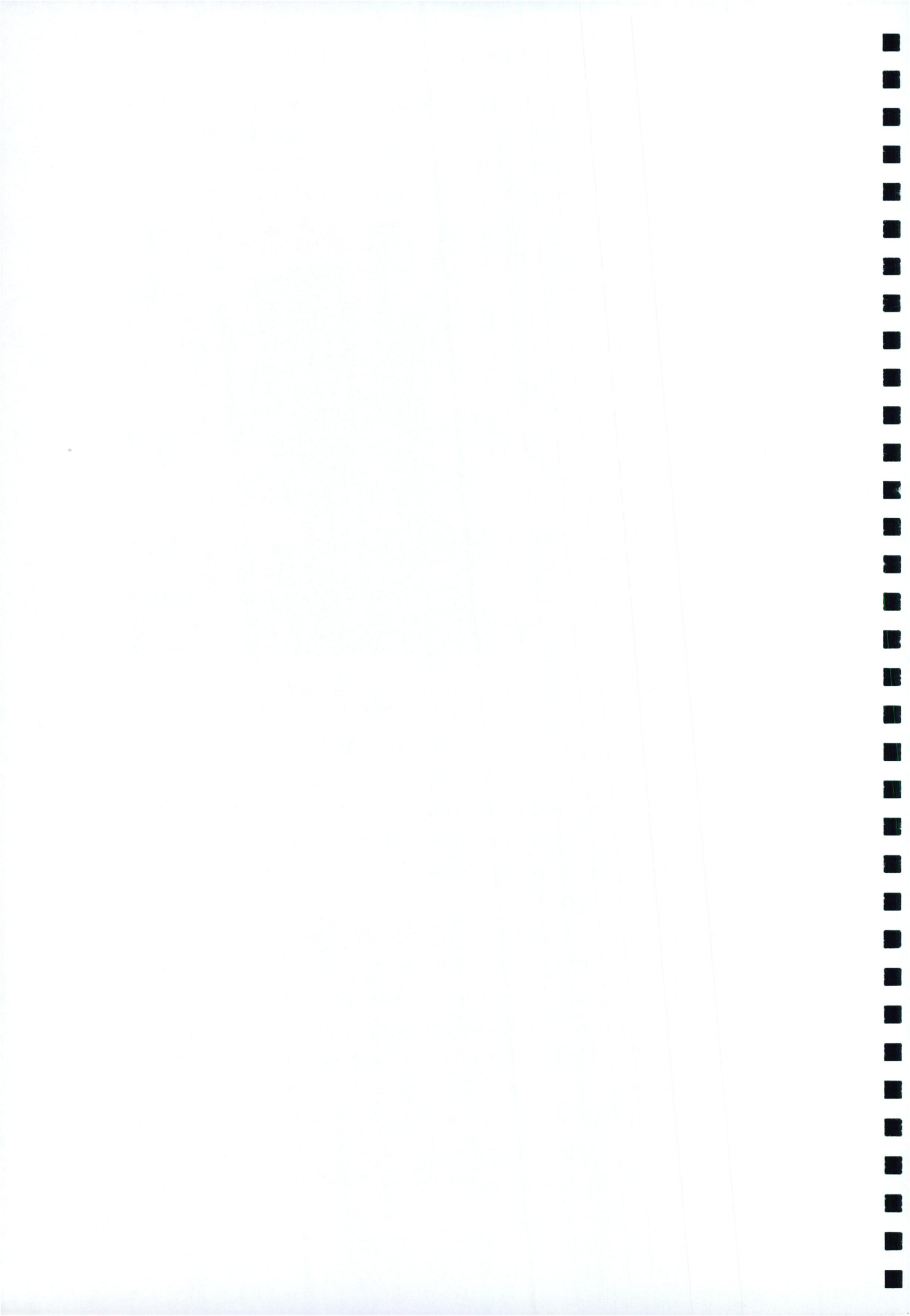
As soon as you sit behind the wheel of an Ursus or Zetor, you will immediately notice the ancient looking 'dash board'. If you then look down to your right, you will see a much smaller number of control levers than a more advanced western tractor. Sacrifices have to be made in order to keep prices down but is it worth that much? The east and the west have two completely different philosophies when it comes to tractor sales. With Zetor, once you buy one of their tractors, you are buying a tractor for life. It is expected to last the farmer over twenty years at least whereas the more expensive western manufacturers encourage people to purchase a new tractor every four years. They figure it would be in the operator's interest to trade in his old model every four years



*fig.28*  
 Cab interior of a 1992 Zetor 9540. Note the basic instrumentation on the driver's pod.

because after only four years, the depreciation value would be a minimum, a newer tractor would be more efficient and he would also receive a 'good deal' from the dealer. The second hand tractor should then be bought by the man who is considering an eastern option because they maintain that a four year old western tractor would represent better value than a brand new eastern tractor. This of course depends on the farmer's intended use for his new acquisition. Zetors are Ireland's best sellers because there are more farmers in this country than contractors. A farmer does not spend a fraction the amount of time in his tractor that a contractor would, and when he is using it, he normally has to mount and dismount regularly so the cab environment is not a priority of his. Add to this that most of the average farmer's tractor work can be gauged by the farmer himself in order to maximise efficiency due to his relatively small output. Therefore, he is more concerned with performance than anything else so it appears that there are grounds for choosing an eastern tractor. What the buyer will only realise with time is the





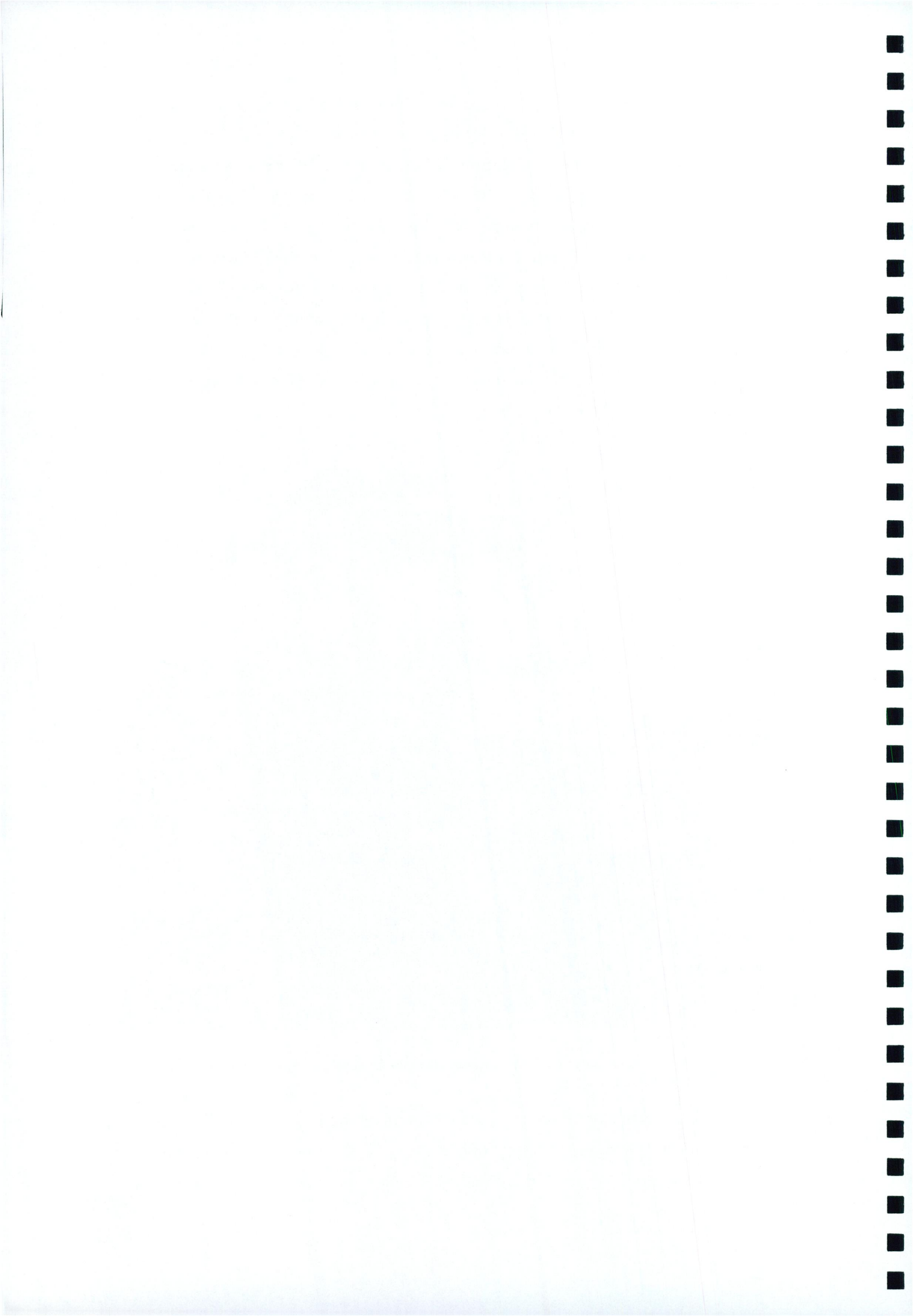
poor quality of workmanship put into these tractors. Eastern tractors are renowned for giving trouble so it stands to reason that Zetor and Ursus buyers are usually 'handy' with a spanner when it is needed because there will definitely be many times like this in the tractor's twenty years plus life. Zetor in an attempt to dispel any such thoughts have brought out a new range of tractors so as to give their tractors a needed boost to their physical appeal. When the designers were given the brief, they were told to continue the eastern philosophy. What they came up with was something that was very similar to its predecessor. Basically, all that had changed was the body styling. Zetor have tried to give their tractors a more westernised look so as to create a more positive image for themselves.



*fig.29*

*A Polish made Ursus 1012. Basic accessories such as the front mud-guards, are optional extras.*

So, will the eastern tractors continue to dominate the Irish market? In Britain, they are nowhere near the top of the scale. Over there, Case International, Massey Ferguson, Ford, Fiat and John Deere are the main sellers. This is due





to the fact that most farming is done by contractors and contractors are concerned with the highest performance levels along with the highest comfort standards. Zetor and Ursus will have to battle hard to retain their supremacy because trends in Irish farming are set by Britain which means that eastern tractors will have to undergo further design improvements in order to conform with the much more professional attitude taken by tractor users. They will have to change their attitudes to design because the future of agriculture does not lie in the past unlike eastern tractor design does.



## Chapter Five: The Future

So where does tractor design go from here? At present, the whole tractor industry is undergoing a rationalisation process which started almost twenty years ago. Take for example that until four years ago, Case International marketed their products under agreement with New Holland. This stopped when Ford bought New Holland and began to sell their machines together now. Both Ford and New Holland have just recently been bought by Fiat who are now beginning to emerge for the first time as Europe's largest tractor giant. In order to compete with giants like Fiat, many tractor companies are sharing their technology so as to be more cost efficient. SAME and Lamborghini, who are both Italian also, supply gearboxes to both Deutz of Germany and Renault of France. There are many other examples like this to be found in the tractor industry and this rationalisation will continue as long as the tractor industry exists. The next major amalgamation to be announced in the coming months will be unusual because it will be the first between the East and the West when we see the arrival of the Czech built John Deere. We can see the pressure that the tractor is under and how the industry's structure is continually changing.

How will this rationalisation effect tractor design in the future? Due to the great improvements in tractor design over the past two decades, the number of tractors needed to work the same amount of land as before has been reduced dramatically. In Ireland last year, only 1,200 new tractors were sold which was an all time low. The prediction for the future is that the number of units sold each year will continue to fall until it eventually stabilises at the figure of 1,000 units a year. One of the many reasons for the reductions in the number of necessary tractors required to do certain tasks is that now, tractors are so powerful that they can come equipped with front hydraulics and power-take-off drives which effectively gives the operator two tractors in one. Tractor designers have ultimately been the main reason for their own demise in their quest to design the safest, most efficient and most productive tractors ever seen.

In future tractor design, the emphasis will swing greatly towards the safety aspect. Of course, tractor designers will seek out more comfortable,







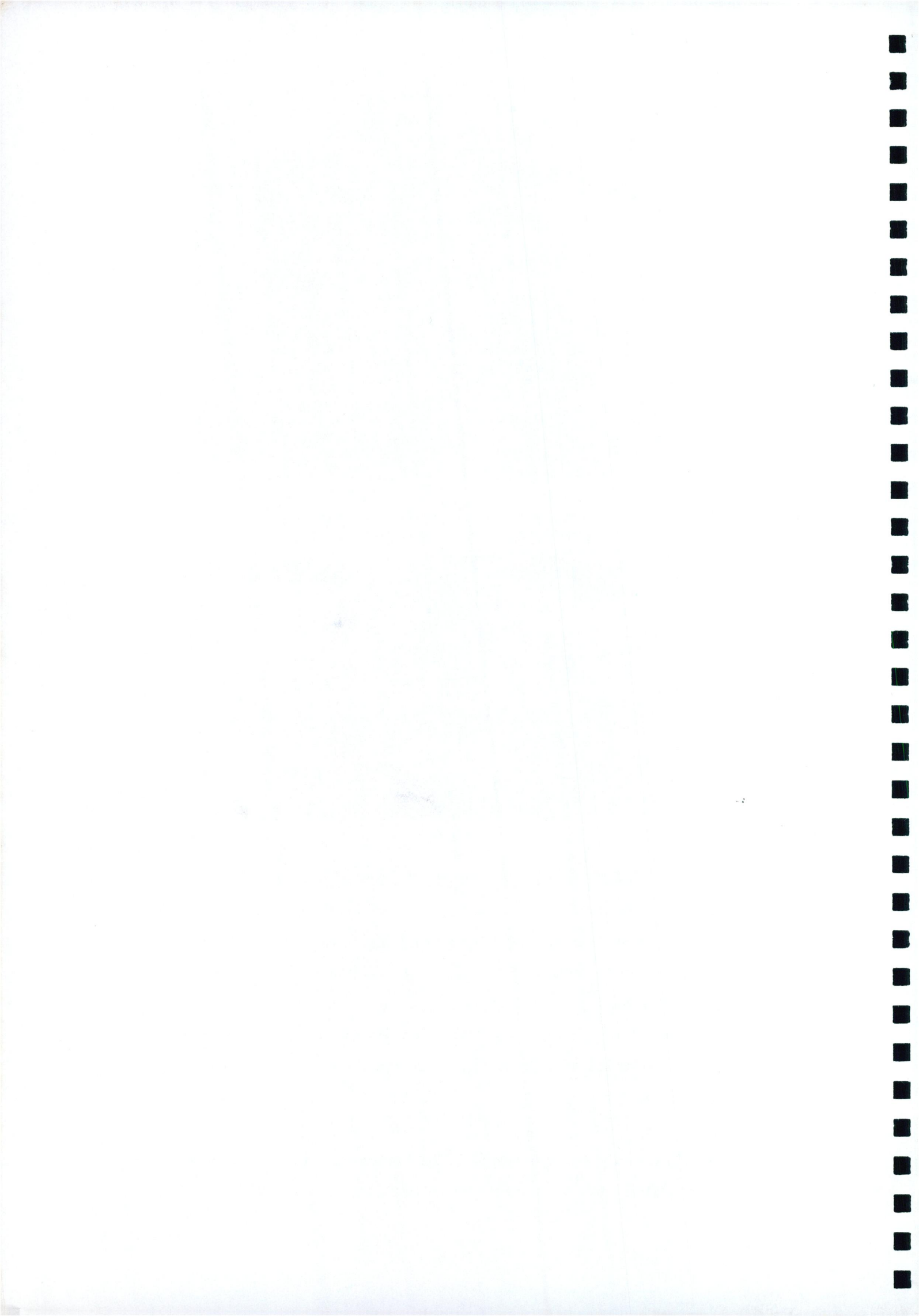
*fig30*  
*A Ford 8730 in transit with a row harrow attached to the front and a trailed seed drill behind and below, the same tractor at work in the field.*



*fig.31*

productive and efficient tractors than all ready exist but due to the high standard at present, the improvements made will only be fractional to those improvements made in the past twenty years. Three years ago, JCB introduced a high speed tractor with a 45mph top speed. This would have been a logical development from tractors with a mid-mounted cab but in field tests, it proved unsuccessful because the tyres used for traction in the field did not cope with travelling at high speeds on the road as well so the idea has been temporarily shelved.

Although, recently, safety has been of the highest standard it is an area where there is always room for improvement. Two years ago, the German Deutz-





Fahr tractor company became the first production tractor maker to offer a sloped bonnet tractor design. This new venture in tractor design is one of the latest in new safety standards. Massey Ferguson have now followed Deutz's lead by introducing their own sloped bonnet tractor in a continual effort to show the public that their tractors are the most up to date, technology wise, available today. Again, due to the novelty of this new design angle, it does come with a much higher price tag than simillarily powered tractors. According to Declan Hayden, the General Manager of Massey Ferguson Ireland, the future of tractor sales lies with the more professional farmer and the contractor. Massey Ferguson believe that these two groups will pay the extra money for the extra technology and performance if it is available to them because it is of paramount importance to the professional farmer and the contractor to obtain the highest quality machinery on the market.



*fig. 32*

*A Massey Ferguson 3065 with a low hood. Note the hydraulics system at the front of the tractor.*



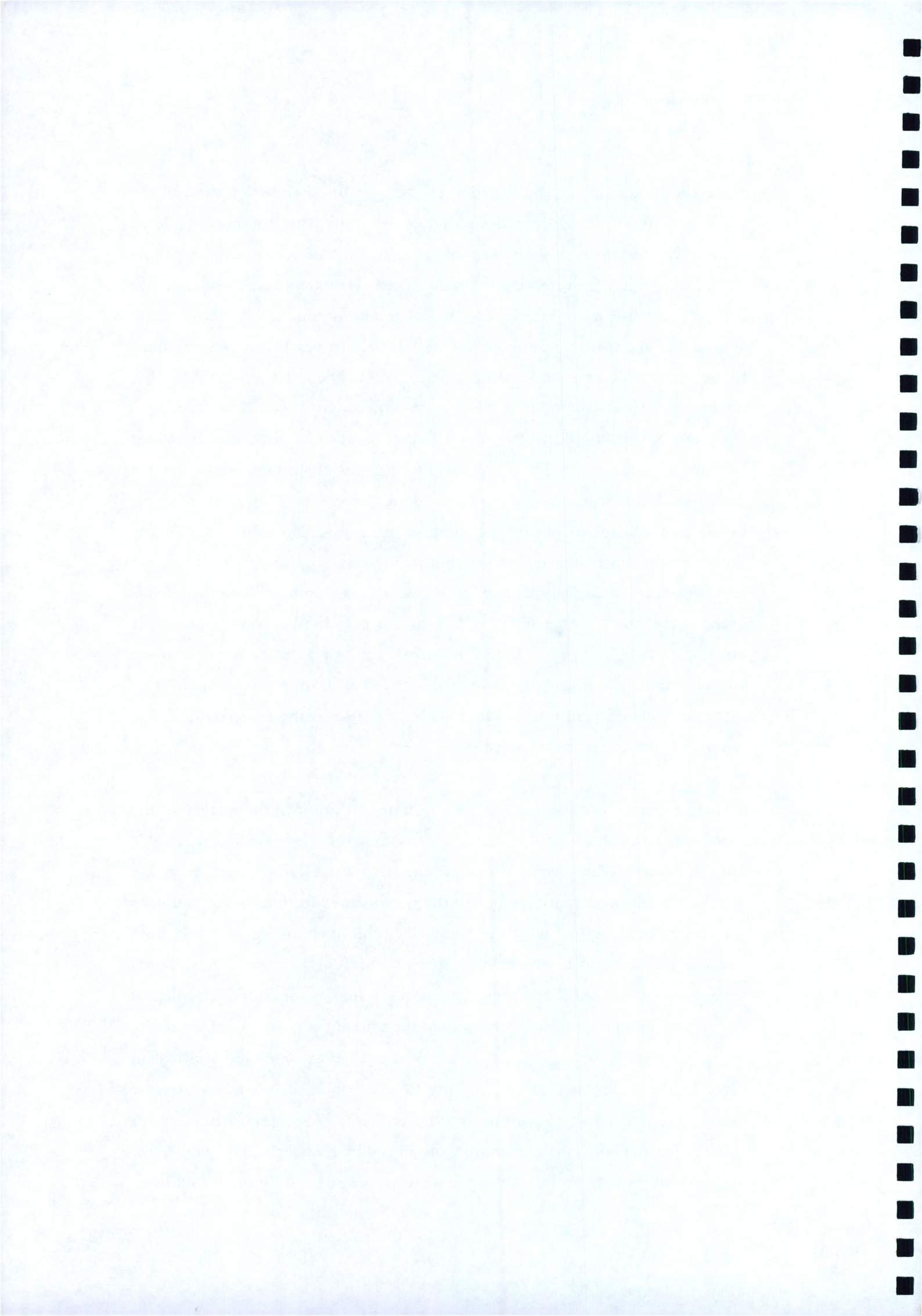


## Conclusion

Since the production of the first tractor just over one hundred years ago, the advancements made in their design could be similarised to those made in automotive design in this past century also. In this thesis we have seen how tractor design has answered the operator's needs whenever asked. Since it was realised how important tractor design was to the production of food, it has always remained on the lookout for better alternatives in order to achieve higher standards of production and efficiency. The tractor company that neglects a serious commitment to any area of design cannot hide their flaws from the buyers. If the tractor has a flaw, it cannot be disguised by token fashionable styling some car companies do. It is this quality that makes tractor design so different to any other field of design; everything about it is honest to the user. There has not been an improvement in audio technology of any great proportions in the recent past but it does not stop somebody like *Sony* or *Philips* introducing whole new ranges of stereo equipment onto the market every six months. With a situation like this, it begs the question, what is the purpose of design anyway? Should it be to disguise reality so that consumers are lured into following some false preconceived fashion trend or should it be to create a better quality of life for us all? The latter is the more sensical, but at present, not the most practiced.

Since the tractor's conception, it has continued to improve the quality of life all over the world. In third world countries, tractors are providing invaluable help to people where before, due to the reliance on animal power, starvation was a frequent occurrence. Although the tractors used in third world countries would not be equipped with the latest electronic technology, they still hold qualities that without persistent development and design advancements, would never have evolved. As this is been written, there are thousands of tractor drivers out around Europe who have been behind the steering wheel of a tractor all day long, and will be there again tomorrow and again the day after and will remain there until the day they retire, working to bring food to our tables. Tractor design has helped these people live better lives by giving them a more comfortable and safer environment to work in and by allowing so few provide for so many, has given us the chance to pursue whatever career we want to in life.





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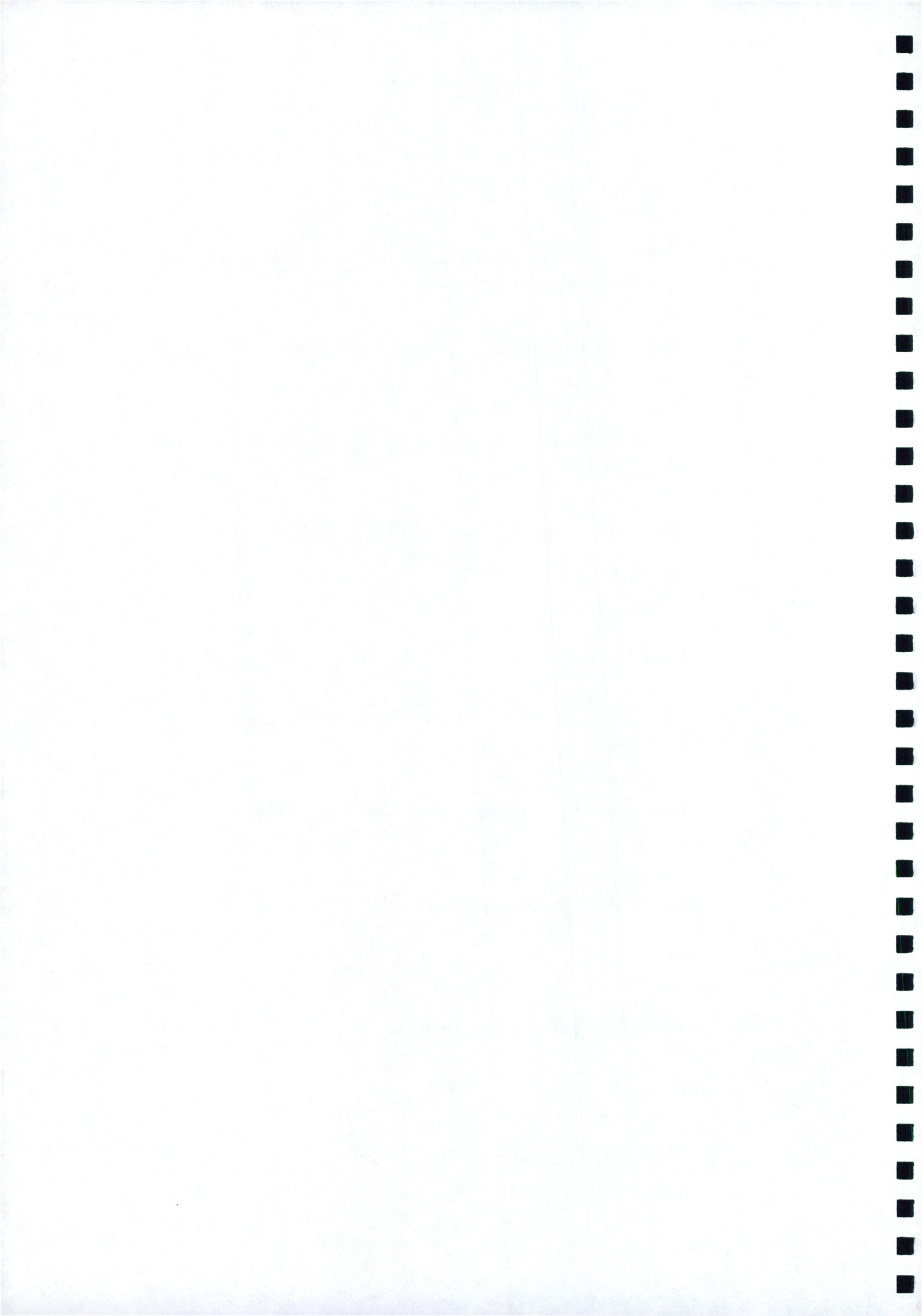
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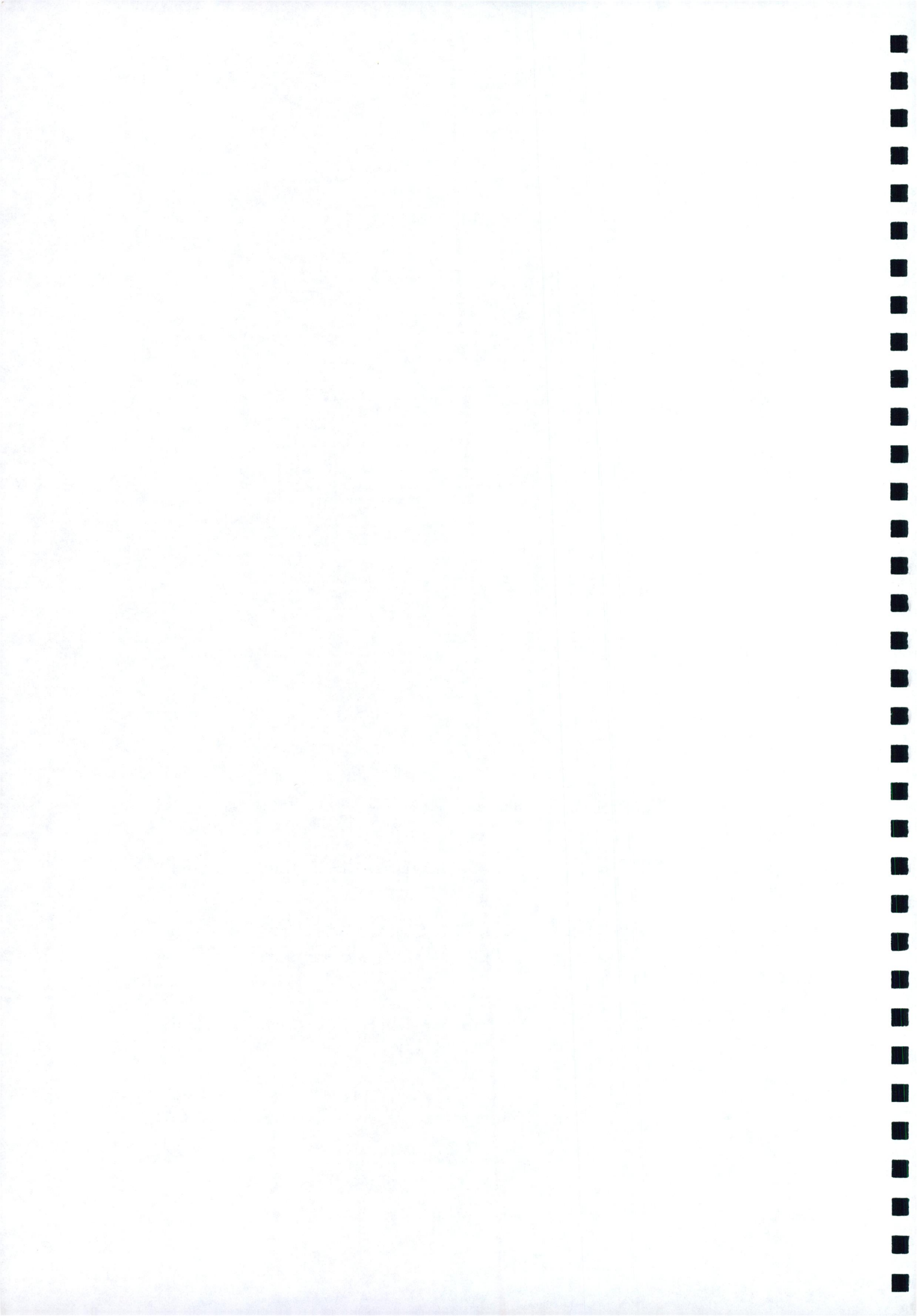




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