CHAPTER 1
THE FIRST FORTY YEARS

The subject of this book is a man of rare character, and the thriving and expanding organisation which he created in the most adverse circumstances and from severely restricted resources. At the time in which the story begins many men were rising to fame and fortune in commerce and industry with few assets apart from enterprise, capacity for work, and unshakeable faith in the value of their ideas. Arnold Redler had all these things as well as his natural gifts and that measure of good luck which usually attends those who rise from humble beginnings to affluence. Not that it is strictly true to suggest that Arnold Redler rose from nothing, for he had for some years practised one trade with a conspicuous measure of success before, at the age of fifty, he dramatically changed industrial horses in midstream, and launched himself on a new venture for which had neither orthodox training nor, at that particular moment, adequate financial foundations on which to build. Only the combination of his unusual gifts and a good deal of courage allowed him to continue through many years of adversity and threatening bankruptcy, until he had made his mark in the new sphere of activity which had captured his imagination, and even contributed to the new industrial revolution which we are living through today, and which is being brought about by the principles of automation.

Due to the lack of documentary evidence much of the story cannot be told in the detail it merits. Arnold Redler was a thrifty man, reluctant to jettison any piece of material or item of equipment which might have served a purpose in the most unlikely contingency, but he sanctioned the destruction of correspondence and out-of-date documents without much reluctance, unaware that he was depriving a future historian of his source material. A few files of correspondence survive which deal with some of the important transactions of his life and are crammed with the faint, almost illegible carbon copies of his letters, most of this, because of his inability to relate, written in his own fair, regular hand. There are also some bundles of notes, again handwritten and often indecipherable, on his patents and inventions, and a few published articles on these subjects which provide one or two details about his personal circumstances and clues to the progress of his enterprise. But most of the facts have been supplied by men who worked with and for Arnold Redler for a number of years, and it is thanks to them that a reasonably coherent account of his life and achievements can be given.

Arnold Redler was born at South Milton, Devon, on the 27th May 1875, one of a family of five children, consisting of a girl, Emma, and three other boys, Daniel, Montague and Gilbert. Both milling and engineering, the interests which were to dominate his life, were represented in the families of his parents. On his father's side were generations of flour millers, whilst his mother came from a branch of the Francis family, one of whom had a distinguished career in engineering. His major achievement had been the invention and development of the Francis water turbine unit by which, at one time, practically the whole of the world's water power supply was harnessed. His large book of experimental data and drawings was one of Arnold Redler's prized possessions, and perhaps did much to stimulate his latent interest in engineering.

Little or nothing is known about his infancy and youth beyond the fact that at the age of ten, he lost his hearing due to a kick inflicted on his head during a game of rugby; this condition continually led to a pronounced impediment in his speech, and there can be little doubt that his disabilities had a far reaching effect on his life and character, accentuating the eccentricity of his behaviour, encouraging him to pursue a solitary, secluded way of life, and perhaps accounting for the fact that he never married.

At the age of fourteen he left school, either because the financial position of the Redler family obliged him to start earning a living, or because his deafness prevented him benefitting any further from formal education. Whatever the reason may have been he entered his father's business at Bathpools Hill, Taunton, and there received a thorough training in the trade which was to provide him with his living for the first thirty-five years of his working life.

Arnold was in his mid twenties when, sometime around the turn of the century, he and his five years older brother Daniel broke away from the family business in Taunton and set up independently in Worcester. They took a lease on a mill which was being administered on a repair and maintenance basis by a solicitor on behalf of trustees, and established themselves under the name of Daniel Redler & Co. Ltd., City Flour Mills, Worcester.

A letter (Fig. 1) survives from the first days of their venture which is worth quoting since it reveals one or two significant facts about prevailing conditions of employment, and confirms the engagement of a number of their staff who remained with Arnold until he abandoned milling in 1925, played an important part in the first experiments with Bin Dischargers and Conveyors, and whose diary of events during the early experimental period will be quoted later on. Dated the 24th January 1900 and addressed to S. Eubery the letter reads:-

> "In reply to yours of today, we believe we applied to Mr. Coombe some time ago with reference to your character, and as Mr. Coombe speaks well of you, you may come on as soon as you conveniently can. Wages £1 per week of 60 hours alternate weekly day and night shifts if necessary. Overtime extra. A week's notice to be given on either side."

From the beginning of their tenancy of the Worcester mill the Redler brothers struggled to operate with maximum efficiency, but their plans for improvements were frustrated by lack of capital. The trustees were not prepared to invest money in the mill so the Redler brothers purchased new machinery out of their profits as and when they could. Relations with the trustees were not cordial, but the Redler brothers continued to work the mill under difficulties until 1908 when a clean break became inevitable, and a search for new premises began. At some point prior to this Daniel had left England for South Africa; what persuaded him to emigrate and exactly when he left is not definitely known, though one source of information gives the date of his departure as about 1906. Also at an unknown time a third brother, Gilbert, had come into the firm presumably to take Daniel's place in the business. At all events when a mill at Sharpness was finally selected as their new premises the lease, granted by the Severn Ports Warehousing Company Ltd., was made out in the name of all three brothers. The lease, dated the 23rd July, 1908, was for fifty years as from the December of that year at a rental of £550 per annum with the lease's option to determine after the thirtieth or fortieth year.

The move from Worcester was made early in 1909, and when the time came the relationship between tenants and landlords had deteriorated to such a degree that a 'midnight flit' was, apparently, the only possible method of exit. Overnight the Redler brothers dismantled the machinery they had purchased and loaded it first onto horse-drawn drays and then onto railway wagons for transport to Sharpness. The original machines were reinstalled and the old chutes refixed, so that the mill was, to all appearances, exactly as it had been when the Redler brothers had taken it in 1900. The whole operation was completed between dusk and dawn.

Daniel, obviously, took no part in the move, but, though he retired from a prominent place in the story at this point, he retained a substantial interest in Redlers Ltd. of Sharpness until the firm went into liquidation.

The main events if his life in South Africa can be summarised fairly briefly. On his arrival he joined the Kaffrarrian Steam Milling Company and later, in about 1910, met another West of England man, F. J. Collier, who had milling connections and a financial interest in the Tiger Fodder Company which

owned an oat milling plant at Mooreesburg in Cape Province. Their meeting resulted in a profit contributing partnership in the development of the Tiger Fodder Company and the oat milling plant. During the 1914-18 war, when the demand for troop supplies was at its height, oat milling activities increased considerably, but on the cessation of hostilities the emphasis moved to the flake side of the oaten product, and the name "Tiger Oats" became famous as the breakfast cereal of the Tiger Oats Company. Later misunderstandings arose between Daniel and his partner which culminated in 1924 with legal action, and led, in 1925, to Daniel becoming sold proprietor of the company.

Daniel's private life was marred by two major disasters; in 1918 his eldest son, Harold, was killed in a flying accident; Daniel concentrated most of his attention on his youngest, Douglas, as his other two sons were up-country farmers without interest or experiences in milling or commerce. Misfortune hit him again in 1926 when Douglas, during a visit to Sharpness, contracted meningitis, died, and was buried alongside his brother in a West of England churchyard. The mill had gone into liquidation the previous year, and Douglas was investigating the possibility of reopening it. A curious coincidence was that his fatal illness like his uncle's deafness, was the result of a blow on the head, though in what circumstances it was inflicted are now unknown.

Daniel Redler was still a comparatively young man and to take his mind off his losses he decided to undertake a complete reconstruction of the oat milling plant on a site at Maitland, four miles from Cape Town. Work commenced in 1928 and a new and revolutionary mill and granary was built, designed more or less on factory lines and incorporating a large and complex system of Redler Conveyors as one of its basic principles of operation and its most innovatory feature.

The construction of the new plant involved a good deal of anxiety and imposed considerable strain on Daniel's health. He contracted a heart condition which demanded specialist advice and treatment, and from 1935 until his death in 1940 he spent long periods in Switzerland, on each occasion paying visits to Arnold, first at Sharpness and later at Stroud. He was never able to resume active participation in his business and in 1936 his responsibilities were handed over to his personal assistance, a Mr. Wheeler, who subsequently became Managing Director of the Tiger Oats Co. Ltd., and the National Milling Co. Ltd..

When Arnold Redler moved in 1909 Sharpness was much as it is today; a small town with a scanty population situation at the junction of the River Severn and the Gloucester and Berkeley Ship Canal. At the extremity of the Bristol Channel, it was the furthest inland port in England capable of receiving ocean going vessels. Large quantities of grain and timber were discharged here for transhipment by canal to Birmingham and the Midlands, by the Midland Railway to Bristol, Gloucester and Birmingham, and by the Great Western Railway, via the mile long Severn Bridge, to the London, Gloucester and Fishguard main line. Sharpness was therefore exceptionally well served by means of communication, particularly in relation to the Midlands, being twenty miles nearer Birmingham than are either Manchester or Liverpool.

The port was well equipped to handle grain shipments. On arrival a ship could be discharged by suction plants which automatically weighed and delivered the grain in sacks or in bulk for railway, lightorago or storage at the rate of 160 tons per hour. The grain warehouses of the Severn Warehousing Co. built along the dock side had a storage capacity of about 1,000,000 bushels.

Redler was able to take direct delivery of overseas wheat in bulk owing to the excellent siting of the mill; it stood only twenty yards or so from the dock side where the draught of thirty feet of water was sufficient to allow the largest cargo vessels of the time to come alongside. The grain was discharged by one of the floating pneumatic suction plants, or by Redler's own plant of 30 tons per hour capacity which was generally reserved for the discharge of smaller, coastwise craft. At the other end of the mill, which stood at right angles to the waterfront, a double railway siding linked up with the Midland Railway and the Great Western Railway lines, and assured the quick despatch of the finished product.

The mill proper was a red brick building 145 feet long, 45 feet wide and seven stories high. Built on to the end farthest from the dock side was a small block which housed the offices, a power house containing a Davey Paxman engine and a Lancashire boiler 30 by 8, fitting shops and mess rooms. Parallel to the mill ran a two storey shed of the same floor area which was joined to it at first storey level by a flat concrete roof. The wide covered passage thus created housed the railway siding where trains were loaded with the sacked flour. The building had probably changed very little by 1920 when the photograph shown in Figure 2 was taken.

Two further leases were taken on land adjoining the mill, one in 1912 with the Sharpness New Docks and Gloucester and Birmingham Navigation Company as leasers, and another in 1920 with the Midland and Great Western Railways as leasers, so that the total site eventually belonging to the Redlers measured 450 feet by 120 feet. The unused land, which accounted for more than half the site, was not built on until the late 20's. By that time Arnold had ceased his milling operations and become an engineer. The demand for his machines was increasing and more fitting and machine shops were needed to cope with the necessary increase in production.

Redler put his mill into operation, and it ran smoothly, as far as we know, and with increasing efficiency until the outbreak of World War One.

The war created a serious manpower shortage, not only because of the demands of the armed forces, but also because when ships arrived at Sharpness to be unloaded what remained of the town's male population preferred to take work as stevedores, as the rate of pay was much higher than that offered by the mills. This drain on manpower was partially compensated for between 1914 and 1918 by the employment of women as packers during the three shifts which comprised the mill's working day. But from 1919, when the men returned from the Front, the women were no longer willing to work the night shift and their refusal was supported by the appropriate Trade Unions and Factory Inspectors, who put an end to the practice at Sharpness as in other parts of the country.

It was this effect of the war on the working of the mill which persuaded Arnold Redler to turn his thoughts seriously to finding the solution to one of the miller's perennial problems; how to discharge from storage bins and convey flour from point to point efficiently and economically by mechanical means. He was convinced that the depleted labour force could be balanced only if the technical answers to these problems could be found. He decided to build some equipment and begin experiments at Sharpness which, if successful, would enable him to concentrate all available manpower on production during two shifts, and then to switch it for the third shift to packing the stored output.

CHAPTER 2
THE BIRTH OF AN IDEA

Up to 1919, when Arnold Redler began his experiments, flour had been discharged from bins almost entirely by hand, a process costly in time and labour. In a manuscript dated February 14th, 1920 and headed "Flour Bin Discharging", Redler gives an interesting description of the manual method of discharging bins which had been used since his boyhood in the mill at Taunton, and no doubt for centuries before that. The passage is quoted verbatim as, apart from the relevance of the subject matter, it is a good sample of Arnold's characteristic style of writing.

> "For many years and throughout the world attempts have been made to discharge flour from bins but without appreciable success.
>
> Pastries i.e. flat bottomed holders or bins have been used for generations and whilst it is obvious flour can be easily tipped into a receptacle either by emptying sacks of flour from a position level with the top of the bin or by elevators discharging into the bin automatically, for emptying the bins manual labour was employed the method adopted being as follows:-
>
> One or more large holes (say 1 ft sq.) were provided in the floor of the bin and a sleeve conducted down to a sack. The sleeve of course would be tied up when the bin was ready to be filled.
>
> When it was desired to sack off, an empty sack would be hung up and the sleeve untied. The flour in the sleeve and probably a perpendicular 'core' of flour above the hole would drop into the sack or consecutive sacks that were hung up.
>
> After the 'core' was dropped out together with more or less of a funnel shape towards the top of flour, resource was made to poking and scooping to loosen a bigger area at the top of the funnel, and according to the 'freeness' or 'cloggyness' of the flour so the funnel would be more rapidly enlarge or otherwise.
>
> This manual 'trimming' as it was called was persisted in until the bin was empty. With very free flour the 'walls' of the 'core' might be too unstable to stand much 'trimming' and consequently they would collapse in a more or less effective manner.
>
> Generally speaking after the first core had dropped down the top surface was the next to be discharged and the flour on the floor of the bin was the last to be sacked off.
>
> As before stated bins were sometimes provided with more than one outlet, especially in the case of bins of larger area, and generally the sacks would be hung up and filled from all the sleeves practically simultaneously. Thus the top of the flour would be funnelled towards each hole and the ridges between the funnels could be more easily poked over into the adjacent holes.
>
> This was the only way adopted so far as I know up to within ten years ago."

The few attempts to which had been made to mechanise the process has met with partial or complete failure, and the same manuscript continues with descriptions of the working principles of all the mechanical dischargers known up to the time of writing, and an analysis of the reasons for their failure. In this way he deals with the old-fashioned mixing box, a trunk or 'pastry' with a reciprocating bottom moving on a slow can which delivered the flour slowly and uncertainly though an aperture at the front of the box; Smith's Patent Mixer which consisted of three Archinedean

worms lying in the bottom of the trunk; Samuelson & Backhouse's Bin Discharger which also work on the Archinedean principle, the screw being set vertically in the bottom of the bin usually circular or polygonal in shape; and Vernon's Bin Discharger which was based on the hopper principle, one side of the hopper being hinged and resting on a can which, in notion, opened and shut an aperture through which the flour would drop into the waiting sack or receptacle.

Redler knew exactly why these machines were unsatisfactory, and he thought he had the answer to the problem up his sleeve He did nothing constructive about it, however, until the post-war manpower shortage more or less forced him to. Then, sometime in 1919, he came into contact with an engineer whose ideas on the subject of bin discharging had been formed by the text books rather than by experience, and observation of the behaviour of materials to be handled. This meeting is described in another of Arnold's manuscripts entitled "The Redler System of Handling Bulk Materials" and dated April 10th, 1930. It reads:

> "It is now, about ten years ago since I first turned my attention to the handling of materials in bulk, which came about as a result of a conversation I had with an Engineer with whom I was having dinner.
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> The subject we happened to discuss was the bulk storage of flour and offals as he thought the tendency of the milling trade was drifting in that direction. He said that at the moment he had an experimental installation being built. He did not divulge on what lines he was testing or how he hoped to solve the problem.
>
> It is well known that for a great number of years engineers in every part of the world have devoted much time and thought to the effective storage and discharge of moist materials from receptacles, but although many ingenious methods had been devised, no practical solution had been found to meet millers' requirements and I was naturally very interested in the conversation. I also volunteered the remark that I thought it would be done by means of chains situated in the bottom of the bin.
>
> This remark excited his curiosity and on return to his office he pressed me to indicate on what lines I suggested the apparatus should be designed.
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> I gave him a rough idea of what was in my mind and followed it up with a letter suggesting that he should co-operate with me in building a test bin at Sharpness. I received a reply declining the proposition but without giving any reason.
>
> Meanwhile, I had come to the conclusion that my idea should be protected so I applied for Provisional Protection and forthwith began experimenting on my own.
>
> I was, however, very puzzled to know why the Engineer had declined my offer of co-operation, so I made a special journey to see him. I ascertained the chief reason was because he considered the power required to drive my proposed apparatus in his opinion would be prohibitive.
>
> My preliminary tests quickly showed that this power would not be excessive and on a later practical experiment I was able to drive the chains under load by means of a (1/2 h.p.) breast drill, with a piece of string transmitting the power to a worm wheel reduction gear.
>
> On my next visit to the Engineer I interviewed his chief draughtsman and asked him what their definition of excessive power to drive the apparatus really meant. He replied that their calculations worked out to about 50 h.p.
>
> This extraordinary calculator was no reflection upon the engineer as he was simply guided by the text books which had been published up to that date. It was evident to me that the

behaviour of materials had never been studied in the right way and that therefore the data which had been obtained was based on incorrect promises.

But 99% inaccuracy so impressed me, that it gave me confidence from that day to ignore Engineers and to proceed in the solving of problems in my own way.

My aim was to adapt my methods to co-operate with the natural behaviour of the material and not to be limited by orthodox opinions or practices. The results were astonishing and fully justified procedure."

This experience with a qualified engineer bred in Arnold Redler a distrust and suspicion of the entire profession which he did not lose for some years. The results of his independence were at first beneficial because he was able, in the early stages of his experiments, to work without the handicap of pre-conceived ideas, but there can be little doubt that later, when the principles of his method of discharging and conveying bulk materials had been proved effective beyond dispute, the development and commercial exploitation of his machines was retarded through his own lack of specialised engineering knowledge, and his reluctance to employ qualified and experienced engineers.

Arnold took up the challenge which had defeated the professionals with characteristic determination. His aim was to build a machine which would incorporate several improvements on all the existing types. First and foremost he required it to run on a very low consumption of power, secondly it should move the stock gently and slowly so as to reduce strain and fiction on the material to a minimum, and particularly relevant in the case of flour handling to keep down dust; thirdly it should draw the flour off the bin in exactly the same rotation as that in which it had entered it, thus avoiding the possibility of any portion of the flour remaining for a long time in the bin, growing stale, and contaminating freshly milled flour as it was added to it.

He thought that chains lying in the bottom of a straight-sided bin would allow this orderly, rotational withdrawal of the contents, and furthermore lead to two additional advantages in the elimination of the hopper, which could cause a great deal of trouble during discharging by allowing flour to avalanche and pack down so tightly into the narrow neck of the hopper that it ceased to flow until dislodged by hand from above; and a reduction in the strain on the sides of the bin which would allow them to be lighter and hence cheaper in construction. This was the principle on which he built his first discharger, and the principle on which they work to this day. In short he had found the answer to the problem with his first inspired guess, and stumbled on a system of mechanical handling of unrivalled versatility and breadth of application.

CHAPTER 3
TRIALS AND SETBACKS

Redler applied for Provisional Protection for the Chain Like Bin Discharger on the 12th August, 1919, was duly granted Patent No. 159236 to cover his specification, and began his experiments.

His first test was made with the simplest equipment. With some stout timber he built a frame about one foot wide, one foot deep and seven or eight feet long, and laid it on the ground floor of the mill, the long sides resting on the ground, the ends raised about two inches, so that he had an open trough with apertures at the bottom of each end. He then stretched several Ewarts chains side by side and lengthwise in the bottom of the trough, leaving a few feet of chain protruding through the openings at either end. He filled the trough with sharps, covered it with a plank which fitted exactly inside the rim of the frame, put a 15 ton jack on the middle of the plant, and on top of the jack a piece of timber which reached up to a beam of the floor above. By this means he was able to exert a downward pressure of 15 tons on the sharps and the chains buried in them. But despite the heavy pressure he was able to draw the chains through the sharps quite easily by pulling, with his bare hands, on the ends which protruded from the apertures in the end of the trough (see sketch in Fig. 4).

The success of this simple test confirmed one of his basic contentions: that a bin discharger built on the chain principle could be driven by a very small power unit, and at very low cost.

He next built a small bin seven feet wide, eight feet from front to back, and about eight feet in depth, divided it down the middle to form two compartments, and again used the floor of the mill for the bottom of the bin, with an aperture at the front three to four inches in depth, and another at the back deep enough to allow passage of chains. This bin he installed on the second floor of the mill which left plenty of space underneath it to collect the discharged flour. He removed a floor board in front of and parallel with the bin and fitted the aperture with a shaft furnished with several sprocket wheels evenly spaced and another board from behind the bin, which aperture he edged with a section of telegraph pole split lengthwise, the rounded side of which served as a tracker for the chains. He ran Ewarts chains over the sprockets, whose pitch carried them just above the floor level of the bin, over the telegraph pole, through the gaps where the floorboards had been, and joined them under the floor to form several parallel loops of continuous chain more or less covering the bottom of the bin. He attached a small power unit, and tested it until he was satisfied that the chains would run smoothly over the telegraph pole tracker and across the floor of the bin towards the sprockets at the front. He then filled the bin with flour half expecting that the weight of the mass would pack it down so hard into the links of the Ewarts chain that it would be delivered in the shape of little compressed cakes. However when the chains were set in motion, at a speed of about 70 feet per minute, the flour was discharged in its correct form through the front aperture, and at such a rate that, before he had time to throw off the belt, it was drifting several feet deep on the floor below.

This experiment he considered only a qualified success, for he could not at first prevent the flour being carried on the links of the chains across the space between the front of the bin and the driving shaft and onto the sprockets themselves; also the rate of discharge was too swift; and the force of gravity favoured the discharge of the flour at the front of the bin.

The first problem caused considerable trouble but was finally overcome, and taught Redler some useful lessons in the process. He found during his experiments that chains spaced too far apart would cut tunnels through the flour in one run, and that the mass above would maintain itself and the tunnels intact so that the chain emerged from the tunnels on subsequent runs with empty links!

He tried inserting attachment links into the chains at intervals and those had the effect of breaking down the walls of the tunnels and getting the flour moving again, but also the disadvantage of easily getting tangled up in one another. The most valuable conclusion which finally emerged from this series of experiments was that in order to keep the flour moving all over the bin at least 75% of the flour should be covered by chains.

The problem of the rate of discharge was solved comparatively easily by reducing the speed of the chains and adjusting the height of the aperture at the point of discharge. But the real stumbling block, and the problem which brought him to a standstill for some time, was the intervention of the force of gravity.

This was his first encounter with a phenomenon which occurs in the handling of all powdered, flaky or granular substances. When any such material is poured onto a flat surface or into a receptacle it naturally, unless disturbed by artificial means, assumes the shape of a cone; new material added to it slides down the mound to its base or the restraining wall of the receptacle, depositing some of its quantity on the way. But the angle of the cone to the perpendicular, in normal circumstances, remains the same and is governed by the nature of the material. This is called the 'angle of repose' and Redler was immediately aware that it had a crucial influence on the design of his discharger. He found this fact confirmed a hundred times over when he later began to adapt his machine for use with materials other than flour.

During the working of his discharger the angle of repose of the flour would drop down to the rear aperture and consequently, if the bin were being charged continuously, the freshly milled flour would fall onto the incline of the mass and slide down and forward to be discharged first, leaving a bulk of produce stagnant at one end of the bin. The discharger was therefore failing to shift the flour in the correct sequence. To try and defeat this tendency Redler adopted a number of modifications. He raised alternate chains on small platforms so that the flour would be agitated on two different levels. He drove alternate chains in opposite directions. And he even resorted to building a hopper in the end of the bin in an attempt to push forward the flour which got left behind.

None of these measures provided the solution, and in fact hoppering created new problems, for the flour would lodge on the inclined plane (which Redler termed 'dead lands') and refuse to move until sufficient bulk had accumulated to cause avalanching. Redler tried to keep the flour moving over the hoppers by covering their surfaces with tin, but the friction of the moving mass was so great that it frequently tore the tin away from the woodwork. He was at deadlock.

The answer to the problem came to him unheralded and unforeseen when he was on holiday one weekend. He woke up one night at about one a.m. and began to think about his bin discharger. In a matter of a few minutes he hit on the idea which was to make the whole thing practicable, and taking some paper he drew a diagram there and then of the machine almost exactly as it was to appear in his final patent specification.

On his return to Sharpness he immediately put his new idea to the test. He built an all timber bin of similar dimensions to the one used for his first experiments, but instead of giving it a flat bottom by setting it up on a floor of the mill, he installed a false bottom which sloped down from the front to the back. At intervals he made apertures which ran from side to side and which he hoped would allow even discharge of flour from the total floor area. The chains were fixed in such a manner that they would pull the flour towards the back of the bin above the false bottom, each link dropping its load through the first aperture it came to and onto the underrun of chain which would carry it forward underneath the false bottom towards the discharging point at the front of the bin. This at least was the theory, but before it became a practical proposition much painstaking experiment and observation was needed to answer such questions as: at what angle the false bottom should be inclined to compensate for the flour's tendency to adopt its natural angle of repose, what size should the apertures be and at what distance from one another, what sort of chain would serve best to cut

through the bottom of the bulk, feed it through the apertures and then convey it to the point of discharge, and so on.

For the first trial runs the false floor was sloped on an incline of one inch in one foot, and consisted of planks three inches thick and eight inches wide placed in pairs with apertures three inches wide between each pair. Ewarts chains of 1.1/2 inch and two inches pitches were used and the gaps between them were about the same as their own width, so that the floor of the bin was half covered by the chains and half uncovered.

The long series of experiments began on this new bin and many and various difficulties were encountered and overcome. In the meantime another, much larger bin was built for flour and when it was completed the first one was turned over to offals, bran, sharps, broad bran and middlings, and observation commenced of the behaviour of these materials and of the way the discharger handled them. It was discovered that bran handled in a completely different manor to flour, and was in fact far more difficult to discharge satisfactorily.

For the new, large bin Redler decided to have built an all metal discharger which he conceived as a mobile unit which could be introduced through an appropriate aperture opened up at the front. He was advised by his Patent Agent to have drawings made to his specifications by mechanical draughtsmen. He approached a firm in Holborn and explained his requirements to them. Their drawings, however, were unsatisfactory, for despite Arnold's instructions they produced designs for a machine with considerably less than the 75% of chain-covered floor area that he now knew was necessary, and assured him that it would be impossible to design a practicable machine such as the one he envisaged, for the apertures in the floor would leave it much too weak to carry the required load of one ton per square foot.

He then designed the machine himself, and took his drawings to a firm of Constructional Engineers who quoted him a price for the job of building the carcase, and accepted his order. A week later he received a letter from them asking him to cancel the order! His design, according to them, was quite contrary to accepted practices, and they had no wish to be associated with what was bound to be a failure. Thus they demonstrated the deep streak of conservatism which runs through a section of the engineering profession!

Arnold, undaunted, approached a second firm of Constructional Engineers and asked them if they would allow a job to go through their works under his supervision and to be entirely his responsibility. He was allocated the services of a man who took instructions only from him, and the carcase, fitted with shafts and bearings of his design, was finally completed, Arnold bearing the costs of overheads and materials. Certain alterations had subsequently to be made, but on the whole the machine was a success and, in conjunction with the large new bin, gave Arnold the opportunity to observe some strange quirks of behaviour in bulk flour.

Running horizontally through the bin about eight feet from the floor and two feet from the front was a wire rope 1.1/2 inch diameter which strengthened the fabric of the mill. On one of the trial runs of the discharger the bin seemed to empty remarkably quickly and no flour was to be seen resting on the chains or the false bottom. But when the inside was examined it was discovered that about a third of the contents, amounting to several tons of flour, was lodge securely between the wire and the nearest wall of the bin; the flour was literally doing a tight rope act! It was thought that only slight vibration would cause the mass to fall, but sticks of wood were pushed into it unavailingly, and more severe treatment also produced little effect. Finally the boiler room poker was used to pump holes through the mass just above the wire, and even then the flour was dislodged piecemeal and with a great deal of exertion. The phenomenon of a mass of flour spanning a gap such as this is known to mills as 'bridging'.

The incident illustrates the more dramatic kind of difficulty which Redler encountered during his experiments, and suggests the recalcitrant nature of the substance, but in the large quantities normally handled by the miller it is refractory and even, and in some circumstances, dangerous. Redler very nearly had two bad accidents caused by broken chains. If, as frequently happened in the early days, two or three adjacent chains broke in the bottom of the bin whilst the rest continued to function, flour would be left standing on the effected chains, and in a large bin this could involve several tons' weight. On one occasion he records that probably twenty tons of flour was slowly isolated on stationary chains in a tall, narrow column against the side of the bin. Suddenly it toppled and fell, the bin burst open under the tremendous air pressure and the flour swept sixty foot along the mill floor, with such force that, in its progress, it twisted a sprinkler T joint on a three inch main at right angles! Another avalanche caused by the same fault created such a shock on impact that several men ran out of the mill convinced that the building was collapsing!

A tremendous amount of time and research went into the design and development of a chain link which would prove equal to all the demands which Redler's new machine was making. He had used standard designs of the Ewarts and Grey types but these did not give the result he needed; the problems he had unearthed were too specialised to be solved by existing chains. He encountered much the same opposition to his designs from chain makers as that he had received from the constructional engineers. Several of them declined his orders on the grounds that the chains could not possibly do the work he required of them, and at last he was forced to get his chains made on the same terms as those on which he had built the first metal discharger. The chains so produced were successful to varying degrees, but the best of them gave efficient and trouble free service for many years.

Chains formed an obstacle to progress for so long that he finally became disheartened and turned his attention to another discharger constructed on a totally different, chainless principle; his surviving description of it are sketchy but it appears to have had a sliding grid which opened and closed at regular intervals above a false bottom, the flour being carried away from underneath the false bottom by some means which he does not specify. He spent quite a lot of time, and between six and seven hundred pounds on the development of this machine before encountering insuperable mechanical difficulties. He called in his Patent Agents to adjudicate between the two machines, they opted for the chain principle and Redler returned to his experiments on the first machine.

So far he had concentrated his thoughts on the construction of a bin discharger, but another unusual phenomenon witnessed in the large test bin convinced him of the practicability of a conveyor built on the chain principle. The bin had been deliberately loaded from the top of the front side and as, contrary to usual practice, the stock was not levelled off it took up its position with the angle of repose sloping down towards the back of the bin. After discharging had proceeded for some time the stock at the back of the bin had been cleared leaving the chains exposed and accessible, and Redler climbed inside through the manhole to match the discharge of the remainder of the flour piled up at the front of the bin. He was astonished to see, when the machine was set in motion, that the whole of the remaining body of material moved slowly towards him, being conveyed as a mass by the chains. Measurements showed that chains 3/8 inch in depth were moving a mass over six foot in height, i.e. more than two hundred times their own depth. He saw that material could be conveyed on this principle in almost any quantity and at a variety of speeds. He began immediately to construct an experimental prototype furnished with open conveying links on a continuous band. His first trials, as with those on bin dischargers, showed that many questions relating to speeds, layouts, and above all the nature of the material to be handled had to be answered before the machine could be called a success, but again his basic principle was proved workable, the experience he had gained through his work on the discharger helped him enormously, and only patient and systematic experiment and observation were required to arrive at the correct formulae.

With this discovery Redler had added a valuable asset to his armoury, and it led by logical steps to his third major innovation. This came through the realisation that his conveyor, a smooth trough lined in

the bottom with an endless chain of links, could be raised to an angle inferior to the natural angle of repose of the material being conveyed, and that the material would continue to move on masse along the trough. From this to the construction of a closed vertical casing fitted with a continuous belt of specially designed links which swept four, three or even two only of the inside surfaces was but a step, the Redler Elevator was born.

Thus at an amazingly early stage of his engineering career Redler had established a complete system of the mechanical handling of materials.

For the most part research on the machine was punctuated by less sensational incidents that those described in this chapter. Trial and error, observation, modification and retrial was the order of most days, and the temperament and patience of a detective were the most valuable qualities the experimenter could possess. Sidney Embery, who as we have seen had joined the Redler brothers at Worcester in 1900, had become mill foreman in 1910 and he combined these duties with those of chief mechanic in charge of the practical side of Redler's researches. His diary for the year 1922 has survived and in it he jotted down brief notes on the progress of the machines in his care. A few extracts picked more or less at random give a clear idea of the difficulties which were his day to day preoccupations:

"January 3rd Broke three chains in above bin. Chains seem strained. Sprockets shifted must be fixed more secure.

February 7th Altering offal bin hopper as sketch no. 1 (see Fig. 5) as it now hangs up in hopper.

February 8th I find that the alteration to the offal bin has not improved it as the offal now pushes the chain out of the grooves.

February 18th Had a lot of trouble with offal bin shall have to take out the hopper that is now in.

February 20th Started to alter offal bin by putting chains all across bin now only half over, other half hoppered.

February 21st Offal bin giving trouble by sticking up etc., on hopper.

February 25th Worked all afternoon altering offal bin. Took out hopper and extended false bottom.

February 28th Started up offal bin after alteration. More attachments required on chains.

March 2nd Started to sack off offal out in floor store. Offal chain discharger not going very well breaking coupling.

March 7th Did up new flour discharger everything seems alright chains divided.

March 9th Gave the new bin a run for a trial with one chain only. Seems to go alright.

March 16th Mr. A. R. went away to South Africa on holiday. Tried new Discharger, broke all the chains at one point. Seems too weak.

March 18th No progress with Discharger. I don't think we shall every do any good with the present type of cog and chain, the pitch of the chain is so irregular a waste of time and money.

March 23rd Mill running well. Discharger chains breaking. Rotten luck. The chains seem to want to be able to slip on bottom shaft on its own.

April 1st	Have not been able to improve much on new flour discharger. Trade rather slack unable to keep it going regular chains still breaking.
April 8th	New chains in trial bin broken all but three – rotten job.
April 11th	G.S. Bin burst three chains working only seems to be the cause (Note G.S. stands for Golden Sunbeam, Redler's best quality flour.
May 13th	G.S. Flour Bin burst three chains only working allowed half bin to hang up and vortex in. (Note: This was probably one of the incidents referred to earlier in this chapter).
June 15th	Repairing bursted G.S. Bin.
September 2nd	Messing with discharger No. 3 all day.
September 4th	Started up the ball bearing shaft to drive Dischargers. Speed very high (680 revs.), gears got hot.
October 3rd	Worn gears getting very hot driving bins too much work.
December 12th	Bran bins chains keeps breaking, shall have to scrap them for stronger ones (Mr. A. R. away).
December 13th	All chains in bran bin broke up shall have to dig it out I suppose and put in stronger chains."

Unfortunately no other diaries or similar documents from the hands of Sydney Embery or Arnold Redler himself have come to light. Most of Redler's notes were written several years later, and being retrospective surveys of his experiments do not enter into all the details of his daily activities, or even observe strict chronological sequence.

The only contemporary clue to his progress in the practical application of his machine in the early twenties occurred in an article which appeared in the issue of the trade journal "Milling" for December 24th, 1921. Arnold Redler was referred to as the patentee of numerous ingenious devices in use in the milling trade at that time, and due notice was given to his bulk storage system and the Redler patent conveyor which was taking flour from bins to the loading warehouse, where it was weighed and sacked ready for storage, or despatched by train and barge. Another. Redler conveyor was being installed at the time of the visit in a specially excavated tunnel which extended from the dock side to the private railway siding, via the covered passed between the two main buildings of the mill. The writer noted that the conveyor was ideally suited for handling incoming consignments of grain, as the links of the chain appeared to be unbreakable, and the conveyor could not be choked or overloaded, thus hitting on two of the outstanding advances in mechanical handling made by Redler's "en masse" system.

In 1921 Redler was still, first and foremost, a miller, and a very efficient and successful one. The writer of the article carried out a complete survey of the mill, commended its situation, its up-to-date equipment and fittings, and its well-appointed laboratory, and had nothing but praise for the management and operation of it, and the progressive policy of its proprietor. He mentioned Redler's inventions without placing particular emphasis on them, and only as they applied to his own trade. There is nothing in the report to suggest that less than four years later Redler's career as a miller would be at an end, and his whole attention be turned to the production of dischargers, conveyors and elevators for many trades and materials outside the world of milling.

CHAPTER 4
THE END OF THE BEGINNING

Experiments continued in the mill until 1924, when a decisive event changes the course of Arnold Redler's life. Redler's interest in the problems of engineering had been growing steadily since he had built his first rudimentary machine in 1919, and, though there is no direct evidence to suggest that he neglected his milling interests, yet the devouring fascination which engineering now exerted on his mind may perhaps have distracted his attention from his former occupation, and tempted him into a less than impregnable financial position. A great deal of time, money and labour was spent on the development of the dischargers and conveyors; we have seen that, probably in a comparatively brief period, Redler spent between six and seven hundred pounds on a series of experiments on one machine alone, a machine which he discarded as a failure. This must have been a small fraction of his total expenditure over a period of about five years, from 1919 until 1924 when the first orders for the products of Redler Patents were received, and the sale of machines began to offset some of the costs of development and production. One can only assume that the capital which subsidised the experiments was drawn from the profits of the mill, and that this drain on financial resources was one of the factors which brought about the liquidation of the mill in 1925.

The architect of the event which finally tipped the precariously balanced scales against Redler Flour Mills and brought about Arnold's total commitment to engineering was Gilbert Redler. His position in the firm has not been defined and it is not know precisely what he did or to whom he was responsible. Arnold was absent at the time of the disaster, probably in London. Gilbert went to Bristol to buy wheat; from Bristol he telephoned the General Manager of Redler Flour Mills, Cyril James Chappell with the news that he intended to buy a large shipment of wheat which he had been offered at a very good price. He was assured that the wheat would market would remain firm for some time to come. He quoted the quantity of grain involved (it was considerable) and the price he had been asked, and Chappell replied that it was too high and that Gilbert should let the deal fall through. Gilbert, However, was quite confident that he was making a sound purchase and insisted that he would buy. The dispute became somewhat heated and Chappell who had no authority to forbid Gilbert to buy, had to content himself with dissociating himself completely from the deal. Gilbert bought the shipment and the market collapsed shortly afterwards.

Arnold's fury on being told that he was saddled with a vast quantity of grain now worth a fraction of what had been paid for it is not on record, but can be imagined. He decided that no additional cost of milling the wheat would bring him to bankruptcy, and that the only solution was voluntary liquidation. Daniel came forward with an offer to the shareholders which was accepted and averted court proceedings again Arnold, and Gilbert, his tail between his legs, went back to Taunton where he probably rejoined his father's business for a short time before setting up on his own account as a pig breeder. He remained a pig breeder near Taunton for the rest of his life. And relations between him and Arnold were, understandably, strained ever after.

Arnold then decided to throw himself whole-heartedly into the development and exploitation of his patents. Those who had real knowledge of his character, and very few people knew him well, agree that his decision was largely the consequence of his exceptional single-mindedness and inability to compromise. Once he decided on a certain line of action it was practically impossible to deflect him from it. So, at the age of fifty Arnold Redler set out to carve himself a new career. His assets, courage, determination and faith in his ideas; his liabilitic no training, limited experience, no capital and no plant or machinery.

But the year 1924 had provided Arnold with a most opportune stimulus. In this year the British Expire Exhibition opened at Wembley, and Arnold booked space for the full duration of the Exhibition, which ran on into 1925. This brought in the first orders, and the bin discharger became a commercial proposition, although a limited one, for the first time in that year. And Wembley led also to a much more important development, the significance of which even Arnold could not have foreseen. This was his first major agreement for the manufacture of Redler Dischargers and Conveyors on the continent, and it was concluded that Buhler Brothers, a large engineering concern in Uzwil in Switzerland. The agreement was renewed at later dates and operated with considerable profit to both parties over the years. In a note found among Arnold's private papers after his death he mentions that, during an unspecified period, he earned £150,000 in royalty payments through this association. These payments finance his operations for some years and it is due only to them that he was able to keep his business afloat until the middle twenties when the first professional engineers joined him and began to introduce more orthodox and profitable methods of production.

The machine which Redler exhibited at Wembley was a far more sophisticated mechanism than the one with which he had made his first trials. Figure 6 shows the side elevation of the discharger inserted into a rectangular bin with perpendicular sides. The front of the bin is opened to a height of about two feet and rests on the casing of the discharger. The floor area of the bin is completely covered by chains and the driving mechanism of the machine extends approximately two feet beyond the front wall of the bin. The discharger is furnished with a rigid, false bottom which is apertured in the ratio of about ¾ solid to ¼ aperture, and which is constructed with sufficient strength to take the weight of whatever material may be in the bin. The fast bottom slopes from a height of about one foot off the floor of the bin at the front down to about one inch at the back, and the apertures, which stretch right across the bin are three inches wide and occur at regular intervals. Resting on the false bottom and occupying its whole width are parallel rows of Redler patent chains, varying in design according to the material they are to handle, which are driven very slowly over the false bottom from the front of the bin to the back where they turn down and travel in the reverse direction along the floor of the bin itself to the front and the point of discharge.

In operation the chains on the false bottom, buried in the bulk of material, slice off a layout from the bottom of the bulk and push it towards the back of the bin; this layer drops through the first aperture it reaches onto the lower run of chains, and thence moves forward to the discharge point. On the commencement of operation the material at the back of the bin drops through the lowest aperture onto the empty chain and forms a stratum one inch thick, this being the available space between the false bottom and the floor of the bin at this point. The one inch stratum moves forward on the under-run of chains until, at the next aperture nearer the front of the bin, it is met by another stratum which fills the increased space which is available owing to the incline of the false bottom. The two strata move forward to the next aperture where they are met by another stratum, and so on until they reach the front of the bin and are discharged. On this principle, with the false bottom sloping at an incline of one inch per one foot, a discharger four feet wide and fifteen feet long would discharge a body of material four feet wide and fifteen inches deep at its deepest point, that is at the point of discharge. The machine is furnished with a regulating gate which allows the flow to be controlled at will, and makes it particularly accurate for the blending of materials drawn simultaneously from different bins and moved, by a Redler Conveyor, into a blending vat or bin.

The machine embodied all the virtues for which the Redler "En Masse" system later became world famous. Redler had christened his system "En Masse" because the material move under the influence of his specially designed links literally 'in a mass' or 'all together' or, as he preferred to think, it flowed like a liquid. The material was not agitated or broken up by rough handling, it moved at a slow though constant speed which nevertheless allowed large quantities to be shifted per hour, and it was in partial contact with the only surfaces of the machine. The machine was a miracle of compactness by comparison with everything which had gone before, and by being incorporated into the bin itself it was space saving and required no bulky and expensive supporting structure. It was

also economical in power consumption, self-cleaning, and subsequently proved to be easily maintained and tremendously durable. As it so often the case when a problem which has baffled mankind for many years is finally solved, the principle of "En Masse" conveying and discharging was extremely simple. Indeed many years after his discovery of the method Redler expressed his surprise that the idea of trying to make solids flow like liquids had remained untried and undiscovered for so long. It was, he wrote, "no doubt party due to the fact that such a phenomenon seemed incredible". It might have remained undiscovered very much longer had not a gifted amateur refusing "to be limited by orthodox opinions or practices" determinedly pursued his own line of though based on his experience of the material of his trade.

In 1924 also Redler overcame some of his prejudice against the engineering profession by engaging his first qualified draughtsman, a Mr. Deacon who stays with him only until early in 1927, but at the end of 1925 performed the valued service of introducing to the firm Frederick Cochrane. From the end of the First World War Cochrane had been a Jig and Tool Draughtsman with Messrs Samuelson, Milling Engineers of Banbury, and he transferred to Redler Patents in the same capacity when his former employers retired from business. He stayed with Redler for twenty years until his own retirement in 1945, contributed a great deal to the progress of the "En Masse" system, and saw it accepted throughout the world as the most advanced and satisfactory method of conveying materials in bulk. He acquired a vast knowledge of the mechanical handling of goods range from gun-cotton to cotton seed, face powder to powdered fuel. His nickname, 'Stemmer' was conferred on him by the men on the shop floor at Sharpness because he was an inveterate pipe smoker; the pipe hardly ever left his mount even when he was speaking! He died after five years of retirement on the 16th November 1950; his recollections of the first years of his employment by Redler would no doubt have made a valuable contribution to a period which is inadequately documented and cannot be given the detailed treatment it merits.

His appointment was made as a preliminary to Redler's next move which was to commence the manufacture of certain parts until his own roof. Until then he had bought all his components from various specialist suppliers, and he continued to buy forgings and castings for many years to come. Late in 1925 or early in 1926, however, he began to buy second-hand drilling machines, milling machines and lathes. He bought quite a number of machines (and a quantity of office equipment) at the sale of the assets of the Worseley Motor Company.

He was now operating on a financial shoestring, and had to control expenditure with great care. He made it a rule never to pay more than £5 for any one piece getting exactly the components he wanted out of his own shops rather than if he had continued to rely solely on the outside supplier.

At about this point in the story Leslie Wheatley, who has provided a tremendous fund of information for this book, first came into contact with Redler Patents. He was serving his apprenticeship at that time, the years 1924/25, with an engineering firm in Gloucester, and was given various machining jobs to do on Redler components such as sprockets, shafts, side plates, backs and bridges. Whatever curiosity he may have felt about the ultimate destination and use of these objects was shortly to be satisfied, for in the early part of July 1927 he saw an advertisement for 'a Junior Draughtsman near Gloucester', applied for the job asking for a salary of £2.10.0 per week, and discovered that the advertiser was Redler Patents. After interviews with the General Manager, C. J. Chappell, and Frederick Cochrane he began his employment with the firm on 25th July 1927. He is now Works Manager, a member of the Board of Directors and one of the senior members of the Silver Links Club.

Arnold Redler was then in South Africa on one of his visits to Daniel, and Wheatley did not meet him until his return at the end of September. He filled his time by doing various designs including, he calls, one for 11" drop forged chain and terminals which were to be supplied to the Fertiliser Department of I.C.I. at Billingham. Then one day shortly after his return to Sharpness Redler came up to his drawing board with several pieces of cardboard cut in the shape of hearts and joined

together by old-fashioned brass bifurcated rivets. He asked Wheatley if he knew what they were, and on receiving a reply in the negative explained that they represented a new, heart-shaped link which he had evolved during the return journey from South Africa for elevating purposes, and that Wheatley was going to 'design' it; by which he meant produce proper scale drawings of the chain. The chain (see Fig.) was eventually manufactured in three sizes and worked very efficiently, but it was too expensive to produce, and not many orders were received for it, though spare parts are still produced and supplied for the machines which were made at that time incorporating the heart-shaped link.

The story of this somewhat disconcerting situation throws an interesting light on Redler's methods of working and the difficulties they imposed on his staff. His education had been terminated early, and as far as is known he had had no formal training in engineering at any time during his schooldays or after then; yet his mind was fertile in ideas, designs, and innovations. But he had to convey these ideas to qualified draughtsmen for translation into correct drawings before they could become tangible objects, and nature and his disabilities had left him ill-equipped for communication. He had absolutely no skill whatsoever with a pencil, he could not draw clearly even the simplest sketch; and he was unable to converse easily and lucidly because of his deafness and the impediment in his speech. So he had to resort to cut-out patterns, rudimentary sketches and a strange, mumbling mode of speech which eventually became intelligible to those who were in constant contact with him, but which, to a total stranger, might have sounded like the wanderings of a mentally disturbed man! Perusal of his written notes, however, reveals a keen and active mind and suggests great powers of concentration, and one can only guess at the frustration he must have suffered during his lifetime in attempting to convey his meaning by the spoken word alone; as his frustration grew so his temper got out of hand and in extreme cases would render him speechless. To his staff these sessions must have been extremely trying, and they would no doubt claim with deep feeling and some justice to have suffered at least as much distress in trying to discern his meaning as he had in trying to convey it.

There are many stories about his difficulties of communications. Jack Heaven was an apprentice in the Carpenters' Shop at Sharpness in the early days of Redler Patents, drove with Arnold a great deal on his trips about the country, and is still at Sharpness as a millwright foreman, living in the bungalow 'Severnsea' which Arnold built to his own design on land adjoining the mill. He recalls that Arnold instructed him on one occasion to prepare a particular component. In due course Heaven produced what he thought was the desired object, but it would not do. He built a second model incorporating what he thought were the necessary modifications. Still it would not do, and Redler's temper began to get a little out of hand. Heaven tried a third time and Redler's reaction was furious. After one or two more equally unsuccessful attempts Heaven, in desperation, produced his first effort again. Redler accepted it with smiles and words to the effect, "Why didn't you do it this way the first time?"

He was an extremely obstinate and single-minded man, of great determination. Leslie Wheatley would often try and argue technical points with him, attempting to make him understand that certain ideas were uneconomical, impractical, or downright impossible. Sometimes he would win his case, but at other times he could argue quite lengthily with no effect until a certain look came into Arnold's eye which he recognised and which, he knew, signalled the end of the discussion. To have persisted any further would have provoked one of Arnold's fearsome tempers. And when Arnold whistled everybody game him as wide a berth as possible. This was an infallible sign that he was ill-honoured, and questions of less than major importance were shelved until the prospects of a calm interview improved!

He was a solitary man, indeed a semi-recluse. He never married or even showed any interest in the opposite sex, and his relations with the various female housekeepers who looked after his domestic affairs were distant and formal. Any sign of less than strictly professional interest in his welfare on the part of his housekeeper led to instant dismissal. He had no friends, and whatever affection he

felt for fellow humans was fixed exclusively on his sister Emma, his brothers Daniel and Montague, and their children.

But for the most part his evenings were spent alone, he would sit in the living room of the bungalow in Sharpness, perhaps writing his correspondence or notes on his inventions, working on new ideas and developments and, for diversion, playing to himself on a church organ which he had installed at considerable cost in the living room. One may ask how a deaf man could possibly play an instrument he could not hear, and the answer is that he played it very loud (though there are those who believe that Arnold was not quite as deaf as he liked people to think he was, or at all events that he was totally deaf only when it suited him to be!) He was apparently quite a professional player. But when, after some years, he moved from 'Severnsea' to more spacious quarters and the sulence of amplification had made large strides in the meantime, he installed equipment which ensured that, when he played, nobody could endure sitting in the same room with him!

Nevertheless he occasionally seemed to feel an overwhelming need for human company, and Leslie Wheatley recalls that at such moments, when solitude had temporarily become unbearable to him, he would go to almost absurd lengths and invent the most ridiculous pretexts to prevent his companion leaving him to his own devices.

CHAPTER 5
BRICKS WITHOUT STRAW

In the absence of the advice of informed engineers Arnold Redler was obliged to work out his own methods of research and production and these were at best unorthodox. It is true to say that until 1932, when he engaged his first professional engineer, he muddled through under the guidance of the spirit of improvisation. Improvisation was also imposed on his staff.

The late Jack Price, who made some notes on his experiences with the firm before his untimely death in April 1964, joined Redler in 1929 after serving a varied apprenticeship in Sharpness, Newport, Cardiff and Barry. His initiation into the ways of Redler Patents gave him quite a shock. One of his first jobs was to cut some 3/8" thick mild steel plate, and to do this he had to take a 14lb sledge and a blacksmith's set down to the railway siding, and cut the plate with the hammer and set using the railway line as an anvil. To Jack, even in that day and age, the process seemed rather "Heath Robinson".

Cutting equipment remained in short supply for many a day. Most of the early conveyor and discharger casings were produced in wood, occasionally lined with metal, until 1928, when one of the leading chocolate manufacturers in the country ordered seven Multi-Chain Wide Bin Dischargers. Their order was one of first to be executed in all-steel models, and the plate for these casings was cut entirely by hand with a pair of shears, the blades 12 to 14 inches in length, the handles extended by pieces of piping 6ft long to give the cutter greater leverage.

(Mr. Wheatley, on a recent visit to the premises of this firm, was surprised and gratified to find that all of these machines, and three others supplied at later dates, were still running smoothly, only one or two minor alterations having been carried out on them; there could be no more handsome tribute to the workmanship which went into them.)

By the time Jack Price joined the firm one hacksawing machine had been added to the cutting equipment, but when it was in use everybody else had to do their own cutting with an ordinary hacksaw frame, even if they were working on angles up to 3" x 3" x ¼" in size. Though Redler was still buying most of his spur gears from proprietary gear cutters he had one Fellowes Gear Shaping Machine in the works, but Jack Price recalls that nobody had had very much experience of the machine and that it was a lucky day when the operator arrived at the end of his cut without leaving room for another half tooth!

Conditions in the drawing offer were not much more comfortable or the equipment much more adequate. The staff had been increased by the end of March 1928 by the appointment of another junior draughtsman who came from the firm of George Waller & Sons Ltd. of Stroud. The drawing office was about 8ft by 20ft with enough space for three drawing boards at the most, and it was in close proximity to a pom-pom riveter which had been installed on the works side. The draughtsmen's concentration was shattered every time the machine went into action, and this always happed, or so it seemed to those in the office, when particularly difficult calculations were being made.

Blueprints were produced by a sun printing frame which left the draughtsmen entirely dependent on the weather. If it was sunny a print could be produced in ten to fifteen minutes; if it was a dull day paper and drawing would be put in the frame and out in the open until 9.00 a.m., and a good print might or might not have developed at 3.00 p.m. or thereabouts; if it was raining they made no attempts to take a print. This method was employed until July 1928 when Redler purchased a half moon type of carbon arc printing unit which was offered at the sale of a nearby engineering works.

The output of prints increased and the draughtsmen were no longer dependant on the weather conditions, but in 1929 even this machine was inadequate and Redler bought a more modern type, a vertical cylinder unit with a carbon arc lamp moving up and down. It was by such small degrees that the Redler organisation increased its efficiency in the early days.

The pressure on the personnel to produce bricks without straw was, therefore, general and constant. Unfortunately there was little immediate material reward for their efforts; Redler paid the skilled men in his employ only 1/-- an hour for a 47 hour week as against the 1/1.1/2 which was generally offered to a skilled turner and fitter in the Gloucester area, and there were several men who were obliged to accept his terms and travel at their own expense from Gloucester to Sharpness every day. At Stroud there are still men who started with Redler at this rate, and Jack Price was one of them. But these were depressed days and men were ready to work in poor conditions, with poor equipment for poor pay rather than not work at all. Arnold Redler was always a hard man in a bargain.

Nevertheless remarkable achievements date from that period, and the organisation despite inadequate equipment and a shortage of technicians, was capable of great things. Perhaps one of the largest projects embarked on in the late twenties was the modernisation of the Pearson & Dorman Long colliery at Snowdown in Kent. This involved the installation of an elaborate network of Standard, Two-way and In-measuring conveyors which provided a one hundred per cent mechanical system for handling the large quantities of coal which were carbonised daily at the plant.

Early in 1927 two large concrete slabs had been laid down in Sharpness as foundations for future extensions to the works and offices. These extensions were put in hand at the end of 1928 and completed in March and April 1929. The resulting long, narrow sheds can be seen, with the mill in the background and Redler's bungalow 'Severnsea' on the extreme left, in Fig. The offices were housed at the front of the building away from the noise of the machine shops. There was room here for a much large drawing office, an accounts department, interview room, General Manager's office, and Mr. Redler's office. The move to new quarters was made without incident, though part of the roof of the new building gave trouble shortly after occupation, and the workman who repaired it slipped and fell through into the room below which, unfortunately, happed to be the ladies' lavatory and, even more unfortunately, occupied by one of the typists at the time. Apparently neither the workman nor the young lady came to any serious harm as a result of the incident!

Expansion of the premises was matched by expansion of the staff. Mr. Wheatley became assistance to the General Manager, C. J. Chappell, and the drawing office staff was enlarged to six men under a Chief Draughtsman. A large range of new designs was put in hand to devise machines to cope with the growing variety of substances Redler was called on to handle, and several new systems such as Side-pull, were launched at this time of extensive research. Redler spent a great deal of his time in the shops watching the work and experiments being carried out on the new machines. He would quite often site on an unturned box in the middle of the shop with his eyes shut and to all appearances fast asleep. Later it was discovered that he had been very wide awake and well aware of everything that was going on around him.

Redler felt that things were really beginning to move and that the time was favourable to a major effort to set the business on a firm basis. His first step was to book space to exhibit his products at the British Industries Fair which was to be held at Castle Bromwich in the following year, 1930. He took quite a small stand, about 15 feet square, but it had sufficient space to display two Heart-Link Elevators and two Horizontal Conveyors, all operating in a continuous circuit. Visitors to the Fair showed a great deal of interest and a large quantity of pamphlets, catalogues and descriptive literature was distributed. Redler interpreted this interest as a forerunner of an unprecedential demand for conveyors and dischargers and was convinced that rapid expansion of staff and plant would be necessary to deal with the expected floor of orders.

Jack Heaven supplies another anecdote from the time of the Fair at Castle Bromwich. He was driving Redler and Chappell home one night in the Sunbeam limousine when he overheard a conversation between them through the dividing glass behind the driver's seat. Redler announced that he had had a brilliant idea which would revolutionise the design of the Redler conveyor. He refused to reveal the nature of his inspiration but said he would make a few notes on the subject as they travelled. Chappell offered to switch on the light but Redler replied that it was not necessary as he was quite used to writing in the dark. When they arrived at Sharpness he invited both Chappell and Heaven into the bungalow to discuss the new ideal and to his extreme annoyance, and his companion's amusement, discovered that he had been writing with a broken pencil, and that not one of his notes was legible.

1930 was also the opening year of the Toronto Exhibition at which Redler took a very large stand which allowed him to exhibit in full the now considerable range and variety of his machines. The stand contained a circuit consisting of the Standard, Tubular, Uniflow, Side-pull, Duo, Two Way, Flexible, Inmeasuring and Outmeasuring Conveyors and the Bulk Abstractor and Bin Discharger. The massive 30" Circuit Redler which dominated the stand was an adaptation of one of the machines which Jack Price remembered working on when he first joined the firm. It was designed as an experimental installation with a rope type of chain with malleable iron castings attached to the rope by bolts. It was found that not enough pressure could be brought to bear on the links to keep them attached to the rope, and the whole installation had to be dismantled and put on one side as a dead loss until the Toronto Exhibition provided a use for the casing and a modified chain. This was an impressive display, a really remarkable effort from a company which had operated on a financial shoestring since its inception only five years before, and was to continue skirting the edge of insolvency for several years to come. Redler himself attended the Exhibition and was accompanied by two engineers named Chipperfield and Davis who had been engaged for a specific purpose which will be mentioned in due course.

Arnold Redler had visited the United States at least once before, in 1923, presumably on business connected with milling, and now from Toronto he paid a return visit in order to set up an agreement for the manufacture of his patents in America. This agreement was made with the Pneumatic Scale Corporation of Massachusetts who formed a separate company called The Redler Conveyor Company for the development and exploitation of Redler's patents in the United States. Patent protection was sought and satisfactorily obtained for all models except the Standard Conveyor which, for some time, could not be adequately covered. However manufacture got under way and, despite the difficulties in the path of the new enterprise, the Redler Conveyor was launched and soon began to make headway. Redler and Pneumatic Scale confirmed their agreement and after a somewhat turbulent honeymoon period, and this led, at the end of 1932, to a most valuable agreement between The Redler Conveyor Company and the Stephens-Adamson Manufacturing Company of Illinois who, though in the first place licensed to manufacture coal handling equipment only, eventually became the major American manufacturers and distributors of all Redler equipment.

Meanwhile, at home, the heavy demand expected to follow the interest shown at the Castle Bromwich Fair did not materialise. Quite a number of new men had been taken on on Redler's instructions, and now they had to be dismissed. The firm went through a period of considerable difficulties and instability during the years 1931/32, and Leslie Wheatley found himself in an awkward situation more than once during that period. A fairly typical incident occurred one Tuesday afternoon when he received a telephone call from the manager of the local branch of Lloyds bank who told him that he could draw only £94. 5. 11. for his wage bill the following Friday; the wage bill at that time was in excess of £800. Mr. Wheatley pointed out that Mr. Redler was somewhere in Scotland, and that Mr. Chappell was away on holiday at an unknown address, and that their absence left him in an embarrassing position. The local manager could do nothing to help as he was working on instructions from the branch at Gloucester. Mr. Wheatley appealed to the manager at Gloucester who explained the situation but could not remedy it. Redler Equipment (as the firm was now called)

had an overdraft of £1,000 for which the bank held the deeds of Arnold Redler's bungalow as security. The Gloucester branch manager had been given instructions to tighten up on overdrafts, and that Redler Equipment had received similar treatment to all the others. There was nothing he could do to help out over the wage bill. On the Wednesday Mr. Wheatley after trying every other resource, approached a firm to whom equipment had been delivered shortly before, J. Bibby & Sons Ltd., of Liverpool, and asked them for a cheque on account. They were fortunately able to co-operate and forwarded a cheque for £500 without delay. The situation was saved by their goodwill and the wages paid out in full. During that period Redler was frequently obliged to take credit lasting up to six months. In fact without the goodwill of both customers and suppliers it is possible that Redler Equipment might have gone bankrupt before the end of 1932.

At the end of 1930 and the beginning of 1932 the business was reconstructed. The manufacturing part of the organisation was re-named Redler Equipment and continued to produce machines for delivery against specified orders. Simultaneously license to manufacture the full range of Redler prototypes was granted to several well-known concerns including Fraser & Chalmers (C.E.C.) Co. Ltd., Henry Simon Ltd., Lodge Cotterell Ltd. and the Birtley Iron Co. Ltd.. Redler Patents became a separate technical and commercial department and a corps of six engineers was appointed to it for the sole purposes of advising the licensees who manufactured the conveyors and dischargers with components supplied by Redler Equipment. The engineers Chipperfield and Davis, who had supervised the Redler stand at the Toronto Exhibition, were two of this group. However the experiment was not altogether successful as, owing to their lack of experience in the field of mechanical handling, the licensees were unable to give the detailed and accurate advice on individual problems which Redler Equipment alone could give. The engineers left Redler Patents after a comparatively short stay.

In 1932 representatives of "Milling" called again at the mill at Sharpness to witness the extraordinary transformation which had taken place since their previous visit in 1921, when, as has been mentioned, they paid tribute to Redler as an outstanding example of the modern progressive miller, and only in passing as an ingenious and inventive engineer.

Now they were greeted by the spectacle of a hive of engineering industry; the workshops were filled with the noises of lathes and drilling machines, hammers and files, the old mill was adapted to a research department in which, under Arnold Redler's personal supervision, all his latest developments and innovations were being tested under service conditions. Here they noted the 30" Circuit Redler (the star of the Toronto Exhibition cured of all its teething troubles) elevating coal or grain at a steady 600 tons per hour at the cost of a few H.P.. Here also they saw the original flour and wheatfeed bins, now fitted with Redler Bin Dischargers, and being used for testing the behaviour of an ever increasing variety of materials. Here the foundations were being laid for the colossal storehouse of specialised knowledge in the natural behaviour and mechanical handling of materials which was to prove one of the Redler organisation's greatest assets in years to come, and to give them a lead in the field which to the present day remains unchallenged. "Milling" published its findings in a long and enthusiastic article in June 1932. The final paragraph was prophetic: "For Redler conveyors have only just begun; and even though they are virtually round the world, their future is great. Applied to flour milling, the source of their inspiration, there are immense and untried possibilities and it will be safe to say that no mill claiming to be modern can possibly do without them. To be really automatic and foolproof, a mill fitted with the Redler system will easily claim pride of place. They are a revelation in ideas and will, without doubt, ensure a revolution in milling design when their merits come to be recognised fully".

All that they suggest and much more has come to pass. Redler machines can now be found in every country of the world where industry plays a part in the economy, and the application of Redler principles has spread to a vast number of industries and materials. Many people believe that mechanical handling has, even now, only just begun its history, and that the part it has yet to play in the automation of industry outweighs the part it has already played in an incalculable proportion.

CHAPTER 6
THE ENGINEERS MOVE IN

In September 1932 Arnold Redler's resistance to the engineering profession broke down sufficiently for him to accept as desirable, if not unavoidable, the appointment of an engineer to the position of General Manager. It was probably the nearly disastrous difficulties of the past two years which convinced him of the advisability of this step. Consequently George E. Allin commenced his employment with Redlers in this capacity at the end of September, and Cyril Chappell was transferred to the post of Advertising Manager. This move naturally led to strained relations between the new General Manager and his predecessor, but Arnold remained staunch in support of Chappell in any disputes which arose, and altogether did his best to sugar the pill he had been forced to administer. After Allin's appointment business began to pick up slowly and the general standard of plant to improve. The favourable trend continued during the following year, with the licensees contributing a certain amount of income.

It now became increasingly obvious that the mill at Sharpness was not a suitable building to house an engineering business which could expect to expand dynamically during the next few years of its life. The main argument against it was the distribution of floor space which, apart from in the newly built sheds, was divided through seven stories. Accordingly, towards the end of 1933 Redler put the mill on the market and began to look for more conveniently designed premises. A Bristol firm, Henry Hosegood & Son Ltd., showed interest in the mill and its adjacent building for the purpose of provender milling, and another firm, Frank Stacey & Co., purchased the flour milling equipment. Hosegoods agreed to take over all the remaining plant and machinery, and the additional buildings which Arnold had erected during his tenancy, including the bungalow 'Severnsea' Arnold was to retain, at an annual rental of £160 and subject to his termination by three months' notice, the bungalow and certain other buildings in which he could continue production until his new residence and works were chosen and ready for occupation.

Altogether three leases were involved in the transfer of the mill to Hosegood, and assignment was considerably delayed by legal complications because, at various times, the leases had been transferred from the names of the three Redler brothers to Redlers Ltd., and from Redlers Ltd. in two cases back to Daniel, and in one case back to Arnold. A large file of correspondence built up as the interested parties and their lawyers tussled over consents to assignment, indemnities and the liability of each party to rent, rates and insurance premium. The property changed hands at £6,250, a price well below that fixed by Arnold's valuers, and the deal was not finalised until July 1934.

In the meantime the valuers, Henry Butcher & Co., had submitted for Arnold's consideration details of the premises at Stroud of a well-known cloth manufacturer, Apperly Curtis & Co. Ltd., then in the hands of the official receiver. On the instructions of the court the works had been put up for tender in three sections and Butcher & Co. suggested that the first of these sections comprising the Dudbridge Mill, two freehold cottages, a power plant installation, the lease on a London office, and the goodwill of the business would suit Redler's purpose ideally. The works offered several advantages; they were well served with electricity, gas and water supplies, well situated with regard to transport facilities, and accessible to a plentiful supply of labour. Moreover the Stroud district was noted for its freedom from labour disputes and troubles, and as far as Dudbridge Works are concerned this is as true today as it was when Redler first moved to the town.

George Allin viewed the premises, signified his approval of them, and an offer of £4,000 was accepted. The entire installation of cloth milling plan, machinery and equipment, was sold, as a separate section, to a Liverpool firm called James Platt & Co., who were acting on behalf of an

Egyptian concern. The removal of the plant fell behind schedule and it had not been completely dismantled and packed for shipment when, in the last week of March 1934, Redler began to move his own machinery and equipment from Sharpness. This was no light undertaking as he had little in the way of transport facilities; material had to be packed for removal in ammunition boxes from the First World War, and cases made up from the 1" boards which were purchased for making packing cases for the transport of the finished product. These travelled by train and dray to the new works, and as Redler moved his plant in so Platt moved the cloth milling machinery out for shipment to Egypt where it was to be installed in a ready-built replica of Dudbridge Mill. Lesley Wheatley saw the plan for this building and noted that every one of the forest of 6" square wooden stanchions which supported the roof of the Stroud Mill had been marked in for reproduction in Egypt together with the exact location of each machine in relation to the stanchions. Figure ... shows the interior of Dudbridge Works (as they were renamed) after Redler had moved in and with the stanchions still in position. Then in 1934 the layout seemed impractical, wasteful of space, and a peer model for the Egyptians to use for a brand new factory.

The firm completed its move and work got under way again. The change of location marked the opening of a new phase for Redler Equipment; in the words of Jack price, ".... from then onwards we never looked back. There was always plenty of work and always something new against which we could pit our brains. In those days also the man on the shop floor could use more of his initiative then is possible today and in my opinion it helped the Company to get where it is".

Arnold moved into a new residence, 'The Lawn' at Cainscross, which, by comparison with 'Severnsea', must have seemed palatial. It comprised four large reception rooms, eleven bedrooms, dressing room, box room, and extensive kitchen quarters and cellarage. There were several outbuildings including a fruit room, coal house, photographic darkroom, potting shed, double garage and stable. All this was set in five acres of ground which contained fruit gardens, a large kitchen garden and an ornamental lake. The house has been used as offices by the Western Electricity Supply Company Ltd. for some years. The entire property changed hands for the princely sum of £1,500, and it is amusing to note, in view of the purchase price, that it cost Arnold £100 to move his precious chamber organ alone from Sharpness to Stroud. His total effects from the bungalow must have been a forlorn sight when distributed throughout the wide spaces of his new home.

The first months of Redler's occupation of Dudbridge Works were clouded by a dispute with one of his neighbours. The property of Apperly Curtis had included much more than that section of their works which Redler purchased. They had in fact granted leases on adjoining factories in their possession to two other companies, Copeland Chatterson & Co., and Stroud Metal had purchased the freeholds of the factories they occupied. Redler inherited with his freehold the obligation to supply electricity to Stroud Metal, and steam for heating and processing purposes to Copeland Chatterson; the latter obligation developed into a cause of considerable bad feeling between the two companies. Arnold Redler at last sought a means of withdrawal from this entanglement, and set in motion what was to become a long drawn out series of negotiations to accomplish this and, Solicitors were once more retained, and counsel's opinion was sought; Arnold not with firm resistance but his determination to bring the arrangement to an end grew with every obstacle he met. In the voluminous file which contains the correspondence relating to the business is a memorandum in his handwriting which merits quotation as an illustration of the extremes he could go to when his hostility was fully aroused. Dated August 8th, 1934:

"REMEMBER

If the Copeland Chatterson hold the right for a long term of years to compel us to supply them with steam

THEN

Refuse to give them any facilities on our property, and insert in any lease or deed of sale of any of our property, that same is not for use, or to be used directly or indirectly by Copeland Chatterson or any business working in conjunction or dealing with them."

The dispute which provided such strong feelings occupied him intermittently until November 1936, and was then resolved by his agreeing to sell to Copeland Chatterson one of his buildings and two portions of land (on terms which, presumably did not embody the above conditions!) as a quid pro quo for the discontinuance of the steam supply.

In the meantime 1935 had seen two events which were of some importance in the progress of the firm. George Allin visited the Stephens-Adamson Manufacturing Co., by then Redler's leading licencee in the United States, and returned with an agreement which allowed Redler to produce a conveying and elevating element to their design known as the detachable link type of chain (Fig.). This link proved to be invaluable to coal handling jobs; it represented quite a considerable technological step forward, and the design has retained its usefulness to this day. (A similar agreement made three years later with Buhler Brothers, the Swiss licencee, added another link, known as the 'Lagos' to the Redler armoury, see Fig.).

The same year of 1935 also saw the formation of Arnold Redler's first private limited company, Conveyors (Readybuilt) Ltd. Arnold was of the opinion that conveyors and elevators could be produced on an assembly line basis and marketed as ready-made machines, in rather the same way as cars are produced. Cyril Chappell was transferred from his position as Advertising Manager with Redler Equipment to become General Manager of the new company, and remained in the post until the 31st August 1944 when, in the evening on his way home he made his usual call at a public house in Frocester, and dropped dead in the saloon bar in the process of raising half a pint of beer to his lips. He was joined on the Board by Charles Barkla, Arnold's nominee and brother-in-law, who made his return to the organisation after a lapse of about two years. At the time of his marriage to Emma Redler, Barkla had been a corn and seed broker at Weston-super-Mare. He had first joined Arnold in 1925 as Advertising Manager to Redler Patents. He remained in his position until 1933 when he joined the firm of Masters & Co., an Estate Agent at Weston-super-Mare who had handled the transfer of the leases on the Sharpness mill.

The original function of Conveyors (Readybuilt) had to be dropped however when it was realised that the Redler Conveyor and Elevator was simply not an assembly line job at that time. Indeed to look on it as a machine which could be put together to a fixed specification was to ignore completely one of its quintessential virtues, it's phenomenal adaptability to a vast number of different circumstances and requirements. It was essentially a custom built machine, tailored to fit a particular purpose and site, and there was little outlet for the ready-made article. The purpose of the company changed quite early in its existence and it began to recondition and to resell machines which were returned from clients who found that they did not work satisfactorily. There was some scope for this, for during the first part of the Stroud era, a considerable number of machines were returned with one defect or another, which it was assumed was due to the excusable ignorance of the principles of "en masse" conveying shown by the many new members of the Redler staff. To them, it must be remembered, the "en masse" theory was a complete novelty, not to say mystery. Conveyors (Readybuilt) finally left Dudbridge works and moved across the River Frome to Cainscross Works, a stone built building which Arnold purchased from the Copeland Chatterson Co.. The negotiations for the purchase of these premises was carried out in a very different spirit to that which had prevailed during the dispute over the supply of steam. Many details were settled by letters exchanged between Arnold and Albert Mann, Director of Copeland Chatterson, and the correspondence composed in terms of cordiality and mutual respect. Indeed their dealings terminated with Albert Mann paying a call at 'The Lawn' and complimenting Arnold on the handsome internal and external arrangements. He also expressed his interest in Arnold's new hobby of cino photography and hoped that he might be present at the next 'showing'.

At about this time Arnold Redler's way of life and work began to change. Up to the time of the move to Stroud, as both miller and engineer, he had kept a controlling hand on every sphere and every aspect of his firm's activities. Now, with qualified engineers and draughtsmen in charge of the technological side of the concern, he made fewer and fewer appearances in the shops, leaving his technicians to translate and convey his instructions to the men at the machine and on the assembly line. At the end of 1934 he left for a tour of South Africa which kept him away from Stroud for as long as six months. He had many differences of opinion with George Allin over technical questions, but was inclined to let Allin, who like many engineers was conservative and opposed to change in engineering practices, have his way.

His attention became more and more firmly focused on administration and finance as time went by. He had always been an astute businessman and his direction of financial affairs was extremely shrewd; he never let go of the purse strings and his over lively interest in money gradually became obsessive. The last few years before the outbreak of the Second World War saw the foundation of his considerable fortune, based largely on royalty payments received from his Continental and American licensees. The parent company was at last making a profit on its own account, and Arnold was able to retain his royalties as just reward for his twenty years of unflagging effort in the development and propagation of his inventions. But for the obstinate opposition to professional engineers he might have built an even larger fortune, and built it sooner. But nevertheless, by 1939 the young miller from Taunton had come a long way, had almost entered the tycoon class, though somehow the word 'tycoon' does not fit the image of Arnold Redler which one carries in the mind's eye.

Meanwhile, under the guiding hand of George Allin, the running of the works became more conventional and more efficient. Plant was improved by the ploughing back of profits in the form of new machinery (new only to Redlers, that is, for Arnold remained adamant in his refusal to pay the price of new machinery when quite efficient second-hand plant could be had for so much less), and in 1939 the first steps were taken in the modernisation of Dudbridge Works themselves, which were still basically the cloth mill Redler had taken over from Apperly Curtis, by making the transfer from direct to alternating current. The power installation of the mill had supplied not only the requirements of the works, but also the current for street lighting in the Urban District of Stroud. The cables which carried the load are now buried under what used to be the engine house and is now the cut-off section. Steam was supplied by two Lancashire Boilers 8' 6" in diameter and was fed to a Davy Paxman Uniflow Engine which generated the direct current required to run the machinery, and to a small Allen Twin Cylinder Vertical Generator Set and one large Six Cylinder Vertical Generator Set. When the time came to change to alternating current the boilers and all the engines were sold to a flour mill at Cam, near Dursley, where they are still giving good service, and a transformer of 150 KVA capacity was installed.

Wages and conditions for the staff improved, and 1937 saw the formation of the first club for the personnel. This was a cricket club and matches were played on a field attached to the premises of another Stroud firm, Erinoid Ltd. It was a rather rough square and to raise funds to relay it and buy the necessary equipment the Committee of the Club organised dances in the winters of 1936/37 and 1937/38 which were held at the local Co-operative Hall. In 1938 the Sports and Social Club was formed which had its clubroom on the floor above the present Sheet Metal Shop. It was equipped with a full size skittle alley, a billiards table, two dartboards, and a table tennis table, and facilities for making coffee and sandwiches. The cost of the equipment and running costs were defrayed by the Club itself, the necessary cash being raised through membership fees and winter dances. The many hours of work necessary to install all these facilities were donated cheerfully by the enthusiastic organisers of the Club. Lesley Wheatley has rueful memories of the skittle alley. Between four and five tons of sand were laid down as a foundation for the floor of the alley, and Lesley, Jack Curtis and Jim Cochrane, the latter two also still with the company, carried the sand up to the Social Club

premises in sacks on their backs. Leslie has it on very good authority that somehow his colleagues contrived to leave the heavier sacks for him to carry!

Arnold Redler, of course, took no interest in these activities. Apart from the fact that he had none of the vices of sociability being a non-smoker and a teetotaller, and live the life of a semi-recluse, he had not the slightest interest in sport of any description. It was not until 1939 that he could be persuaded to attend a social gathering, one of the firm's reunions which were held at Tuck's Cafe in Gloucester, and which were the predecessors of the Silver Links Club functions of the present day.