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NON OIL-BASED ORGANIC CHEMICAL PRODUCTION : THE ROQUETTE FRÈRES' CHALLENGE

by

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Overview

Roquette Frères was originally a company which manufactured starch for the textile industry. Today it employs 6,000 people, has a turnover of 2.5 billion Euros, and has a presence in about one hundred countries. Roquette produces glucose polymers from potatoes, wheat, maize and peas. These polymers may be used in both the nutrition/health industry and in the plant-based or 'green' chemical industry. With the depletion of fossil resources, the prospects for the biomass-based organic chemical industry – which will gradually replace the petrochemical industry – are huge. The most important factor is to identify correctly the molecules which are likely to be the first to 'change over' from the petrochemical industry to the organic-based chemical industry, by taking into consideration technical, functional and economic factors. However, Marc Roquette is already looking even further into the future : in 2100, and provided that energy is abundant and cheap (as is predicted by thermonuclear energy), it will perhaps be micro algae which will produce a large part of our plastics… and even comprise what we eat.

TALK : Marc Roquette

I graduated from EDHEC, the Lille Business School, and I have been the President of the Roquette group since 2004. Roquette employs just over 6,000 people, 2,400 of whom work abroad. Our turnover is 2.5 billion Euros.

Last year, the company celebrated its 75th anniversary. It was founded by my grandfather Germain Roquette and his brother Dominique, and produced potato starch which, at the time, was imported from Holland by the textile industry in northern France. The company's original site at Lestrem in the Pas-de-Calais *département* now covers 150 hectares, and 35 to 40 % of the group's activity is concentrated there.

Roquette has factories in several European countries as well as in the United States, China and Korea. It also has a minority shareholding interest in an Indian starch company. We have four factories in France : as well as the Lestrem factory which manufactures starch from maize and wheat, there is a potato starch plant in the Somme *département*, a pea starch plant in the Aisne *département*, and a maize and wheat starch plant in Beinheim (Alsace).

Roquette is the second largest starch producer in Europe, and the fourth largest starch producer and processor in the world. It is the world leader in raw materials for injectable products (1.5 million people every day are drip-fed with products made by Roquette in France or in the United States) and is the world leader in polyols, and dry sugars (such as sorbitol, mannitol, maltitol and xylitol). It is also well represented in all starch-based excipients for the pharmaceutical industry (approximately sixty different products). Overall, the group has a commercial presence in more than one hundred countries.

Roquette's core business

Our core business consists of producing glucose polymers from different primary agricultural products containing starch flour or starch. These include potatoes, maize (since the post-war period), wheat (since the 1950s) and more recently, starch- and protein-rich peas. A wheat starch plant cannot produce maize starch, but the basic principle is the same : the soluble, fatty, cellulose and protein elements are taken from the plant to obtain flour starch or starch. The term 'flour starch' is used for plants which grow underground, and 'starch' for plants which grow above ground, however the substance is the same and, unlike in French, just one word – starch – is used in English. In total, we treat 6 million tons of primary materials every year cultivated on 550,000 hectares of agricultural land.

As well as starch, we produce more than 200 different products which have more than one thousand uses. Modified starches are used in the papermaking industry, human nutrition and the manufacture of wall paper adhesives ; dextrins are used in the packaging and papermaking industries and the manufacture of adhesives ; malto-dextrins are used in infant nutrition ; glucose syrups in confectionery and carbonated drinks ; dextrose in injectable solutions ; polyols in the manufacture of chewing-gum, sugarless chocolate and toothpaste ; organic acids are used as antioxydants in meat products, as setting retarders for concrete, or as complexing agents for washing bottles.

The human nutrition sector accounts for 49 % of our sales ; animal nutrition 15 % ; paper and corrugated board 14 % ; bio-industries and chemicals 11 % ; and pharmaceutical and cosmetics 10 % (particularly sorbitol which promotes the retention of moisture and prevents toothpaste from drying up : white toothpaste contains 25 % of sorbitol which is derived from maize or wheat ; in transparent pastes, this may be as much as 70 %).

Reasons for our success

When the company celebrated its 75th anniversary, we tried to find reasons to account for our success. I think there are two main ones.

The first is related to the extraordinary potential of our core business. Our two founders had no idea that the product which is the life-blood of the company, glucose, would prove to be the molecule of life. Produced by photosynthesis, glucose is transformed by vegetable enzyme systems into lipids, polymers, proteins, vitamins, and so on. Everything begins with this molecule, which is also the foundation of the petrochemical industry because oil and gas come from the sedimentation of micro algae, while coal comes from wood. It is reasonable to say that the entire petrochemical industry (like the plant-based chemical industry) relies on the exploitation of glucose in a form which has been synthesised millions or hundreds of millions of years ago. Our business consists of exploiting the enormous potential of glucose beyond just fossil raw materials. We feel that despite the considerable progress made in our field we have only uncovered a small part of it.

The second factor behind our success concerns our employees. When the company was created, there were 80 starch producing plants in France. Today, there are only two. The two founders, assisted by an engineer, Adam Grünewald, left their mark on the company and created a corporate culture based on respect and trust which is still present today, and which is also characterised by a taste for innovation. We have been carrying out R&D since 1951. Our R&D budget is 40 million Euros, and we employ 250 researchers.

Prospects for the evolution of the organic chemical industry

In 1998, the American Department of Energy published a graph showing the evolution of the role of the biomass as a raw material in the organic chemical industry. The term ‘biomass’ covers everything from sugar cane, maize, and wheat to cellulose. According to this study, the proportion of biomass will increase from 7 % in 2000 to 50 % in 2050 and to 80 % in 2100.

The swing from the petrochemical industry to the plant-based chemical industry

I am convinced that this change has already started, and I can see some preliminary signs. When I began my career in 1977, millions of cubic metres of ethylene were still being transformed into ethanol, a basic synthon for organic chemistry. Today, all ethanol is produced from cereals, sugar cane or beetroot. In Brazil, where the price of biomass is cheapest, they are even starting to make ethylene from ethanol by removing a water molecule. Another example was when lactic acid was made half from oil, half from sugar in 1977. Today, the production of lactic acid has increased greatly, but mainly due to the increase in the biomass-based part of its manufacture.

Changes in the prices of wheat and oil

Another indicator is the relative change since 1950 in the prices of wheat and oil, expressed in dollars/tonne (not corrected for inflation). Prior to the 1973 oil crisis, wheat cost 4 to 6 times more than oil. Since 1980, oil has always been more expensive than wheat apart from 1995. As a whole between 1950 and 2009, the price of wheat has increased by a factor of 2.8 and oil by a factor of 40.

In 2008, the price of oil per barrel reached a record high of 140 dollars, in other words 950 dollars per tonne, whereas the price of wheat also increased markedly to 300 dollars per tonne. For the first time, there was a three-fold difference between the price of oil and the price of wheat. This was interesting because the same relative difference could be found between the energy content of oil (12 megawatts per tonne) and that of wheat (4 megawatts per tonne). In other words, in 2008, for the first time, there was a correlation between the price of these two raw materials and their energy content.

Since then, the price of oil has sharply fallen as has that of wheat, so that the ratio is now between 1 and 3. For some products, therefore, it has become economically possible to change from petrochemical-based to plant-based. When chemists work with oil which does not have any oxygen, they have to take oxygen from the atmosphere (where it is in abundant supply) to insert it into the oil molecules. However, when they work with elements from the biomass (which includes on average 50 % oxygen), they have to remove oxygen from the biomass (because there is too much of it) but they are not penalised for doing this. Depending on the reasons, the uses and the likely chemical pathways, one may either want to start off with oil or the biomass. The decisive factor is the economic criterion.

A punter's life

The business of an industrialist who is interested in the plant-based chemical industry bears some similarities to that of a punter. If one compares petrochemical products to horses, one could estimate that the petrochemical 'corral' has between 300,000, 400,000 or maybe even one million horses. The plant-based chemical industry has only between 20,000 and 30,000 products. Sooner or later, all the horses from the first corral will move towards the second, but it is very difficult to predict what the order will be. This is the crux of our business, identifying the next molecules which will change over from the petrochemical industry to the plant-based chemical industry.

We think that some molecules we have chosen are rather well placed. Succinic acid is currently made from oil, but in collaboration with the company DSM, we intend to manufacture it from glucose, and we are not alone in thinking that the factory price of succinic acid will be more competitive if made in this way. For a number of years, we have also been working on isosorbide which is derived from sorbitol, and we have already registered a few patents for the purification of this molecule which is particularly delicate. Like succinic acid, it is a 'platform' molecule which can be modified in numerous ways in order to make, for example, laser disks (60 % from isosorbide) and also optical glasses, computer screens, solvents, and even flexible plastics.

The organic chemical industry in 2000

The organic chemical industry, as we know it today, relies on the use of oil, natural gas and coal, both in the form of raw materials and in the form of energy, because the petrochemical industry uses a great deal of steam and electricity, like the plant-based chemical industry. Therefore, the organic chemical industry, in particular in countries where electricity is produced from fossil fuels, causes massive emissions of CO_2, with disastrous effects on climate. The situation is particularly worrying in India and China, countries which use a great deal of coal which is the most polluting and emissive fossil fuel. In France, we are lucky to use electricity which is essentially nuclear and therefore emits very little CO_2.

The organic chemical industry, as is practised today, is characterised by a very long production cycle, lasting between 20 and 300 million years. Even if we discover new gas and oil deposits, we will consume resources, which have taken a great deal of time to accumulate, in a very short space of time. Thus, this is therefore not sustainable.

If one tries to place the petrochemical industry in relation to the three 'ages' of humanity (hunter-gatherers, agriculture and farming, industry and trade), it would fit among the 'hunter-gatherer' activities, which correspond to an ancient period of our history.

The organic chemical industry in 2050

In 2050, we predict that the organic chemical industry will consist 50 % of primary agricultural materials and 50 % fossil fuels. In the light of the constraints which will be put on carbon emissions, we will undoubtedly have greater need of renewable energy sources such as hydro-electric power. We will also turn to geothermal sources for the production of steam.

Solar or wind energy, on the other hand, would be difficult to use because factories operating with organic chemical sources represent huge capital investments and have to work 24 hours a day. This is why nuclear energy will undoubtedly play a much more important role than we imagine it will today.

In fact, we were pioneers in this area. When France started its nuclear programme, it was difficult for EDF at certain times to get rid of the electricity which was produced. Twenty-five years ago, EDF gave us an electrical boiler which we used throughout the month of August when there was a particularly large surplus of electricity. When the price of hydrocarbons starts to soar again, we will have a second reason to change over to nuclear electricity : its price will be very competitive compared to that of oil, and because we know how to use electrical megawatts in a much more economical way than steam megawatts, we ought to be able to reduce our consumption of energy by 20 % by producing all our electricity from nuclear power. Furthermore, using electricity from nuclear sources will allow us to stop all carbon gas emissions definitively, whereas currently we emit 1million tonnes of CO_2 per year.

As far as exploitation of the biomass is concerned, the production cycle will be less than two years. From the point of view of the 'ages' of humanity, organic chemistry in 2050 will correspond to the age of agriculture as far as raw materials are concerned, to the age of hunter-gathering as far as geothermal and hydroelectric energy is concerned, and the age of industry for nuclear energy.

The GAÏAHUB® and BIOHUB® programmes

We are determined to make this change and with this in mind, we have launched two important research programmes.

GAÏAHUB®

The aim of the first programme, GAÏAHUB®, is to modify starch in order to make it compatible with other polymers produced by the petrochemical industry. The aim is to be able to make alloys using our raw material and the fossil raw material. We are starting to produce granules similar to those which are used by all the plastic processors to make plastic bags and parts for the car industry. Our factory prices are still higher than those in the petrochemical industry, but some of our products have characteristics which are more attractive for some applications than those of oil-based products. The plastics sector is so huge that we have to try to find market areas which allow us to develop our derivatives correctly.

BIOHUB®

The second programme, BIOHUB®, was initially financed by the AII (*Agency for Industrial Innovation*), and is currently subsidised by the OSEO. The programme studies how to transform glucose using chemical processes, biochemical fermentation processes and biochemical enzymatic processes, in order to produce derivatives such as sorbitol, isosorbide and succinic acid. In the BIOHUB® framework, we are trying to make methionine directly from glucose. Today this molecule is made exclusively from oil with a series of chemical conversions (requiring a great deal of energy) and intermediary products which are relatively dangerous to one's health. We hope to make methionine by culturing microorganisms which are genetically modified and grown with glucose. It is an ambitious gamble, but one where we have already made some interesting progress.

Collaborative research

BIOHUB® is a collaborative research programme bringing together universities and about fifteen companies. This approach, which is compulsory in order to take part in the AII programmes, was like a small-scale revolution for our company, and helped us to understand that, in an increasingly complex world, one cannot work alone to bring together all the ingredients necessary to satisfy the market.

We quickly launched another programme, ALGOHUB®, in the nutrition/health sector with a consortium of about fifteen industrial partners. This programme involves using micro algae. We are currently establishing agreements with partners. Examples of products which have resulted from this diverse research include technical polymers, agricultural films, plasticizers, PVC for tubes and floor coverings, resins, solvents, and fluxing agents for asphalt.

The Beinheim factory

To the extent that we are getting involved in processes which are not petrochemically based, we want to be proactive and organise our production so that ultimately we have no more CO_2 emissions at all.

In our Beinheim factory in Alsace, we have decided to decrease these emissions by more than 75 % by 2012. We are already making biogas using the methanization technique from residual water. This represents energy of 2 MW/h, but we have two even more wide-ranging projects for which we have just received support from the ADEME (*French environment and energy management agency*).

Since Beinheim is located in a densely forested area, we can first of all use wood to make steam. We intend to install a boiler which will burn 145,000 tons of wood, with a thermic capacity of 43 MW/h and which will give yields of 86 %. The system will allow us to avoid emitting 76,000 tonnes of CO_2 per year, and is equivalent to the substitution of 30,000 toe (tonnes of oil equivalent) per year.

The second project concerns geothermal science. Alsace has France's largest geothermal potential and, due to a European research programme, for the past twenty years the pilot site of Soulz-Sous-Forêts has enabled us to acquire very important knowledge in the field. Our project consists of drilling 3.5 kilometres deep, bringing water to the surface at a temperature of between 160 and 170°, and then, as it is very corrosive, transferring the heat from this water into non-corrosive water. The site where the experts are advising us to dig is 15 kilometres from Beinheim, and so we will have to build a pipe to transport the pressurised hot water over this distance. Our starch plant will be modified to benefit from this hot water source which, for example, will be used for drying purposes, before being used for hothouse cultivation. The entire scheme will have a thermal capacity of 24 MW/h. The investment is being financed by the company (40 %), Électricité de Strasbourg (40 %), and the Caisse des Dépôts et Consignations (20 %).

We have also launched a programme to improve energy efficiency. This should enable us to increase the amount of renewable energy we produce from 75 to 90 % while at the same time reducing our energy consumption.

The organic chemical industry in 2100

To conclude, I would like to present you with my 'thoughts based on experience' – as opposed to my predictions (as I often find that people who make predictions make mistakes) – on what the plant-based chemical industry might look like in 2100, as well as the sort of energy and biomass which might be used.

Thermonuclear energy

It is thought that the sum of man's scientific and technical knowledge doubles every 7 years. This represents an increase of 10 % per year. At this rate, humanity's technological strength in 2100 can be calculated to be 13,780 times greater than that of 2000. It is very difficult to imagine what we may be capable of at that moment, but it seems very likely that man will have mastered thermonuclear technology.

This technological break with tradition will enable us to use a source of energy at a very reasonable price. In the knowledge that because of technological progress factory prices of products decrease by about 3 % per year (in constant Euros), there is no reason to think that this rule cannot also be applied to energy. According to this calculation, if the MW/h costs 30 Euros today, it ought to cost 1.4 Euros in 2100.

Switching over to thermonuclear energy will also present huge savings in terms of natural resources. To produce the equivalent of electricity provided in one year by a 900 MW nuclear power station, one would have to burn 6 million tonnes of biomass. If it were carbon, this figure would be 2.5 million tonnes, and oil, 1.5 million tonnes. To produce 900 MW with thermonuclear energy, one needs 250 tonnes of uranium per year ; whereas for thermonuclear energy, only 150 kilos per year.

Micro algae

Today, the petrochemical industry consumes 300 million tonnes of oil per year. To obtain the same result, and in view of the by-products and waste, biochemical production would need 900 million tonnes of biomass. If one were to triple demand from now until 2100, this would represent 2.7 billion tonnes of biomass, which, even with the greatest desire to improve agricultural and forest yields, would lead to deadlock.

Having used potatoes, maize, wheat and peas, we are now looking at micro algae. At the moment, they are expensive and are only used for products with high added value in the nutrition/health sector. Using them to make chemical products or biocarburants would not make sense at the present time economically, but it might well be possible one hundred years from now.

Micro algae are cultivated in photo-bioreactors, in other words in huge transparent streamers filled with water and arranged in rows, several metres high inside greenhouses. Micro algae are of interest because their volume grows fourfold every 24 hours. If the greenhouses are lit artificially day and night, the productivity and quantity of these plants per square metre can be increased. The sun can only light one layer of streamers at a time, whereas artificial light can be installed to light several photo-bioreactors at a time placed one on top of another. Energy costs, however, are not negligible.

Rates of productivity can be huge if one couples the cultivation of micro algae with the creation of thermonuclear energy (either by lighting photo-reactors or by supplying electricity to the biochemical factory). The cultivation of micro algae produces 30 times more biomass per hectare than does agriculture as it is practised today. By using artificial light for the cultures day and night, this could be 100 times more, and if one superimposes ten photo-reactors one on top of another, one could reach a biomass production per hectare 1,000 times greater that that of present-day agriculture.

We currently need 300,000 hectares to supply our Lestrem factory. With this micro algae system, we would only need 300 hectares. The by-products would not be the same as they are with wheat or maize, but the products themselves would be identical. This process would be completely industrial, would have no CO_2 emissions, would not use agricultural land and would have a production cycle reduced to just one month.

In nutrition terms, it would also be a revolution. In prehistory, man needed several hectares to find food as a hunter-gatherer. In 1961, according to figures from the *Institut national de recherche agronomique*, the surface necessary to feed an individual was no more than 0.45 hectare ; in 2003, as a result of agricultural progress, it has fallen to 0.25 hectares. If one divides this surface by 1,000, one calculates 2.50 m2 of space necessary to ensure a food supply for one person from micro algae.

DISCUSSION

Biodegradable and bio-sourced plastics

Question : *Do plastics made from plant-based organic processes have the same characteristics as those produced by the petrochemical industry ?*

Marc Roquette : When we started talking about using starch to make plastics, many people said 'as these plastics will be made from plants, they will be biodegradable'. This is not so. The origin of the raw material has nothing to do with the biodegradability of the product. One can make biodegradable plastics from oil and non-biodegradable plastics from starch. The biodegradability of a plastic, in other words its capacity to be altered by micro-organisms, requires water, but plastics repel water. For it to be biodegradable, the plastic must first of all be made friable which is not suitable for all uses of plastics. Plastic components intended for cars, for example, have to be durable for several years. The sister of a co-worker, who is a pharmacist, wanted to buy biodegradable bags for her pharmacy. She ordered a large quantity and put most of the stock in the attic. Six months later, she went into the attic and saw that there were no bags : they were indeed biodegradable !

As the applications for biodegradable plastics are relatively small, we prefer to concentrate on 'bio-sourced' plastics, in other words plastics made from biomass which does not produce fossil CO_2 emissions.

We are currently conducting interesting discussions with the CEA (French atomic energy commission) which wants to promote the manufacture of fuels made from biomass or from household waste which is rich in carbon. This could be a potential use for kerosene for which it will be very difficult to find an alternative. In this way, our products would have a double life cycle : firstly in the form of plastics and secondly in the form of fuels.

The climate-energy contribution

Q. : *When one uses one tonne of oil to make fuel, one has to pay a climate-energy contribution, but this is not the case when it serves as a raw material for the petrochemical industry. This arrangement is not in your favour.*

M. R. : You are absolutely right. We are also penalised by customs duties which are more costly for agricultural-based products than oil-based products. When Europe has a surplus of maize and the world price is relatively high, due to competition there is relatively little difference between the two. However, when harvests are small in Europe, the difference is large compared to our global rivals. If one wants to encourage biomass-based organic production, one must solve these two problems : namely, one must ensure that we can benefit from the same prices as our rivals outside the European Union ; and secondly, one must tax oil as a raw material and not just as a source of energy. Even when it is used to make plastic or chemical products, oil always ends up by being burned and emitting fossil CO_2.

The order of the horses in the corral

Q. : *How do you ensure the reliability of your forecast with regarding the order in which basic synthons will change over from the petrochemical industry to the biochemical industry ?*

M. R. : For some products, this is already the case. No-one today would ever think of investing in ethylene-based ethanol. The same is perhaps true for lactic acid and succinic acid. Once the changeover has taken place, it is irrevocable. The trouble comes with identifying the molecules which are in the process of changing over.

Q. : *Are there any fundamental laws in chemistry or economics which would define the order of the changeover ?*

M. R. : If one removes distortions which may be linked to rules, one does indeed find basic laws. The simpler the chemical pathway, the less energy it requires and the more competitive the process.

Q. : *A 1998 report from the US Department of Energy categorically identified the 12 molecules which will be the first to change over. There are a certain number of technical problems which need to be sorted out, in particular fermentation in large volumes. However, the list of these molecules is known and shared, and is very reliable.*

Q. : *Does the order in which they change over depend on the importance of market expectations ? In your opinion, which are the markets where one must make an effort to be more innovative ?*

M. R. : In the nutrition/health sector, it is clear that the potential for micro algae is much more important than any other of our raw materials. In the past, people needed calories to give them energy to live. Then, they wanted calories and taste. Today, they are thinking about their health, and in this sector, the potential for micro algae is huge.

As far as plant-based chemical production is concerned, it already exists in the market for example in the form of methionine or succinic acid. We are thinking in terms of substitution, even if in some cases we can give better performances. Take isosorbide, for example, which seems to have better properties in terms of transparency than its oil-based equivalent. Some products from plant-based chemical production can also have a greater compatibility than oil-based products which are alloyed with natural products.

Progress in the United States

Q. : *In your talk, you hardly mentioned the United States. And yet, 80 % of patents concerning biotic energy and micro algae are registered by Americans either in the academic world or in US start-ups. Can you afford to ignore this ?*

M. R. : I have explained that the collaborative approach was a recent move for us and one on which we are very keen. We are in the process of increasing our partnerships including those with American companies. There is no doubt that they are a step ahead of us in research, but the changeover from petrochemicals to plant-based chemicals is a very wide-ranging phenomenon, and a company like ours can only be viable if it chooses a few molecules on which to concentrate. Take isosorbide, for example : here we have an advance because we have been working on sorbitol for a very long time, and we have some patents in this area including one which we bought in the United States.

As far as patents registered for micro algae by the Americans are concerned, I remain sceptical. There are perhaps fifty to a hundred companies whose strategy consists of making Diester® based on micro algae. I am not at all sure that investing in these companies is very profitable. The idea of producing 30 times more oil per hectare with micro algae than with a field of rape is a revelation to everyone, but that does not necessarily mean that the oil in question will be less expensive than rape oil or palm oil. For the time being, it is more reasonable to reserve the use of micro algae to products with a high added value.

Competition from cultivated land

Q. : *In 2050, we will have to feed 9 billion human beings. In countries where there is intensive farming, arable land not used for crop-growing is on the increase. At the same time, it is said that we need 4 times the agricultural area of France in order to produce as much ethanol as we consume in oil, without mentioning the resources necessary to replace plastics and other products derived from oil. How will you make sure your supplies will be adequate ? Would it not be a good idea to buy several thousand hectares in Argentina ?*

M. R. : All companies interested in the plant-based chemical industry take this problem very seriously. We are currently thinking about how to strengthen our partnerships in the stages earlier on in the production process, especially since some of our competitors are agricultural co-operatives. Having said that, competition introduced by the plant-based chemical industry can be positive : when demand increases, prices rise and farmers can benefit from this.

On the other hand, we are not convinced about the use of biofuels regardless of the type of biomass from which they are made. Our Beinheim factory produces 100,000 tonnes of ethanol, but we only went into this business because of pressure from the government and the European Union. In the end, we created a relatively limited project by trying to reduce CO_2 emissions to a minimum.

We are very closely watching Renault's experience of working on an electric car which will be sold without a battery. In petrol service stations, robots will remove the empty battery and replace it with a charged battery. It is clear that we are moving towards these sorts of solutions. In terms of transport, electron-based fuel will certainly go much further than carbon-based fuel provided that of course we can develop nuclear energy properly. How can we cope with future needs without it ? In 2050, with 9 billion people on the planet, the world GDP will be multiplied by 4 and energy consumption will double if we have managed to increase energy efficiency in the meantime. How can one double global energy production ? I like quoting Jean Monnet who said *'Men only accept change if they see the need for it and they only see the need for it in times of crisis.'* We will undoubtedly have to wait until the crisis gets worse before we understand that if we want to react to the energy challenge, we need to give nuclear energy more importance.

Family matters

Q. : *Research carried out by students at the École des mines in Paris has shown that in the race for efficiency in business, family-run companies such as Michelin, L'Oréal, PSA, Bouygues and Lagardère came out on top, followed by very technically-orientated companies such as Air Liquide or Essilor. Your company enjoys both these assets. However, this study uncovered the Achilles' heel of family-run companies : companies which are managed by members of the family are more precarious than those which are run by salaried employees. What is the situation with Roquette ?*

M. R. : One says that when a family-run company has managed to reach the fourth generation, the most difficult phase is over. When there are 5 shareholders, we can manage to agree on most things. When there are 200, we take a vote. However, between the two, with about 50 shareholders, there are sometimes some messy situations. One must move forward and pass through the stage where one abandons one's 'natural family rights' because one belongs to a certain branch of the family, or one's god-given rights to sit in the president's chair, and instead move towards some form of democracy. I am strongly in favour of such changes.

Nevertheless, it is traditional in our society to rely heavily on talented collaborators such as the engineer Grünewald at the beginning of our company's history. At Roquette Frères, we have got into the habit of appointing a member of the family as president and a non-family member as the managing director. Our current MD is Guy Talbourdet who joined us from Faurecia having worked at Valeo before that.

Institutional shareholders

Q. : *The developments which you envisage require a great deal of investment. What part of your capital is owned by institutional shareholders ? Is this percentage likely to increase in order to help change the orientation of your company ?*

M. R. : Currently, the capital is entirely in the hands of the family. In the 1960s and 1970s, we sold 25 % of our shares to Rhône-Poulenc. We bought them all back on two occasions, in 1986 and 1993. Specialised chemical production is clearly more compatible with family capitalism than the chemical production for the manufacture of consumer products. At the present time, there are practically no family-run companies in the mass petrochemical industry, whereas there are a considerable number in specialised chemical production sectors.

One of the advantages of collaborative research is sharing expenses, while at the same time allowing the company to increase its know-how, to benefit from opportunities and to detect areas of potential for greater profitability. The more profitable we are, the greater the chance we have of remaining independent. From this point of view, the state has never helped us as much as it is doing now, whether that is in our BIOHUB® and ALGOHUB® programmes, or the projects launched in the context of our competition poles, or additional financing brought by tax credits for research, or the future abolition of professional tax.

Presentation of the speaker :

Marc Roquette : graduate of EDHEC, president of Roquette Frères since 2004, member of the *Académie des Technologies*.

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