You may remember from your freshman chemistry class that some solid substances generate heat when mixed with water and others absorb heat. Sodium hydroxide, as indicated above, generates considerable heat. Concentrated sulfuric acid poured into water generates so much heat that an explosion results.

Potassium bromide (KBr), a white crystalline salt cools water upon mixing and is the basis for a means of cooling the air in large installations such as the one at BYU. In this process, the water is chilled by adding KBr to it. The chilled water is circulated to radiators which are cooled by the chilled water. A fan blows air through the cooled radiators which, in turn, cool the air. The chilled water is circulated to every building on campus. The water, of course warms up as warmer air flows through the radiators. This warmer water is returned to the central air conditioning and heating building located adjacent to the industrial arts building on the south-easterly part of the campus. The KBr-water solution is then heated to evaporate the water, leaving solid KBr behind and the process of dissolving the salt in water is repeated all over again. Therefore, heat is used to produce cold! How about that!

You experts will recognize that I have oversimplified the process for the layman.

Another menial task was carrying 80 pound glass jugs, called carboys, of concentrated sulfuric acid up several flights of stairs to the chemistry laboratory. I was about twenty years old at this time, non-muscular, slight of build and weighed 125 pounds. This task severely tested my physical capacity. Somehow, I had to survive. I dearly needed that 50 cents per hour wage.

There were no elevators in the mill. There were only "man lifts" and stairs to get from the first floor to the 9th. A man lift consisted of an endless, leather belt about 18 inches wide on which, at intervals of about 12 feet, was fastened a single step. About five feet above the step was a "grab-bar". The belt with its appurtenances travelled the full height of the building through a series of 36 inch diameter holes in each of the floors.

The belt was a continuous loop travelling over a pulley at the top and a pulley at the bottom which caused the belt to move at a rate of about one foot per second.

Though dangerous, Such man lifts are still common in today's production facilities. To use the man lift going up to a higher story, you would wait for the grab-bar to reach the level of your chest, grab it, and quickly place your foot on the step. As you approached the last story of the factory a large visual warning sign told you to get off. Otherwise, you would go over the top and kill yourself! Going down was the reverse of going up.

To reduce my struggle to carry the carboy up the stairs, I decided to use the man lift. First, I nudged the carboy along the concrete floor to the edge of the man lift opening. Then, while standing next to the carboy, grasped its handle in my right hand with a white-knuckle grip. When the grab-bar reached chest level, I grabbed it with my left hand and, an instant later, snatched the 80 pound carboy off the floor and hung on for dear life. Upon reaching the chemistry floor, I lowered the carboy to the floor and instantly jumped off the lift. Providentially, I didn't break the glass carboy, injure others on the lift or kill myself.

Someone in the mill saw me do it and reported it to the chemistry lab manager, Robert Knudsen. Fortunately, Bob had sense enough to see that having a 125 weakling trying to handle eighty pounds was too much and I got out of this task.

Later on, Ida-Rose and I were married on September 24, 1941 and had rented a tiny, furnished apartment in Lucy Van Cott's home, a former Dean of Women at the University of Utah who never married. It rented for $15.00 per month. Lucy was a character! Among other interesting traits, she believed that one must sleep outside in the wintertime to remain healthy. Consequently, she had small, screened, sleeping porches on each of the four corners of her house. Our corner porch was screened on the east and north sides. A door from the screened porch led to a small sitting room which, in turn, led to a door that opened into a community hallway. All renters shared a community kitchen, shower, and toilet facilities.

When winter's northeast blizzards crossed our bed we really had to hunker down with the hot water bottles. Fortunately, the flat bedsprings were week in the middle, creating a hammock effect that kept us very close together. Maybe it saved our lives.

While at Lucy's we learned of the attack on Pearl Harbor. I was enrolled in a difficult physics course taught by Professor Tugman and was studying our text: "Principles of Electricity" by Page & Adams. While I was so engaged, Ida-Rose was putting a puzzle together in the kitchen when another renter came in and said, "the Japs have bombed Pearl Harbor.

Then Ida-Rose asked, "Where's Pearl Harbor" and was told that it was in Hawaii. Her response was, "They wouldn't dare! Renters began to come out of their rooms and gather in the kitchen. The mood was somber. We all sensed that our lives would be changed by this event.

I was now in my senior year at the University of Utah, Bob Knudsen had given me the opportunity to stay in school but work week-ends at the mill in Ogden.

On Friday afternoons, I would get on the Salt Lake Electric trolley with a student strip-ticket that cost 4 cents per ride and go to the end of the line at Beck Street on highway 89 near the Wasatch Hot Springs. Then I would "thumb" a ride to Ogden.

Hitch-hiking was not particularly dangerous in those days and I usually got to Ogden without delay. Then I would head for my parent's home on foot from where I was dropped off, get my bicycle, ride it to the mill and start work at about 4:00 pm.

I got off work at midnight, biked to my parents home at 526– 27th street, slept until 7:00 am Saturday morning and had breakfast with my family. Then came the 16 hour shift. I returned to the mill at 8:00 am and worked until 12:00 midnight.

The next day being Sunday, I spent the morning with my parents and four brothers, and went to church in my old 18th Ward at Jefferson Avenue and 27th Street. In the afternoon, I would get back on the road and hitch-hike to Salt Lake City, catch the street cars and get back to my beloved Ida-Rose. Incidentally, she was working at Woolworth's in Salt Lake City, having had previous work experience at the Ogden store.

After our first year of marriage, we began comparing earnings. In addition to my flour mill earnings, I had a paying job at the U. of U. chemistry department stock room. My earnings were considerably more than hers. I felt that she didn't need to work and suggested that she give up her job. She went to a neighbor's phone, called the manager and quit.

Ever since, I have been able to support an old fashioned, traditional family. For this, I am truly thankful.

I have already told you of the menial tasks required at the Sperry Flour Mill; namely, carrying the carboys of sulfuric acid and the mixing of the sodium hydroxide solutions.

These chemical reagents figured in my scientific chemical tasks:

1. The determination of the protein content of the various strains of wheat used in making each type of flour.

2. The determination of the residual ash resulting from the combustion of the wheat in a furnace to determine the overall mineral content.

3. The determination of the amount of moisture (H_2O) in the wheat.

All of these measures were critical to the manufacturing processes.

The protein determination was the most complicated and involved several chemical steps. The procedure used was entitled "The Kjeldahl Method" and was used throughout the world.

It's time again, now, for another freshman chemistry lecture. The following steps are taken in order.

1. Grind the wheat and weigh out a fixed number of grams.

2. Place the wheat in a Kjeldahl flask. This flask is bulbous at the bottom and has a long slender neck.

3. Add concentrated sulfuric acid (the liquid in the carboys), sodium sulfate (a white powder harvested in wintertime from the Great Salt Lake), and a small amount of selenium (found in garlic) to the flask. The selenium catalyzes the reduction of the protein to ammonia (NH_3), a gas responsible for the odor from your baby's diapers or your cat's litter.

4. Put the flask in a special gas burner wherein the

neck of the Kjeldahl flask is connected to a vent system to carry off the poisonous gasses evolved in the heating. The flask is heated to 725°F for one half hour. Note: boiling temperature is 212°F so 725°F is very hot. At this point, the wheat has disappeared and the solution is clear

5. The solution is cooled, diluted with water, and neutralized by the strong caustic solution of sodium hydroxide that you will remember burned my skin and lungs while I was mixing the ingredients. Since sodium hydroxide (NaOH), is a stronger base than ammonia the gas is driven off and collected in an acidic solution of known molality (strength).

6. Finally, an iodometric titration is performed using a burette and a red-dye end point indicator.

7. From the information obtained in the experiments, the protein content of the wheat can be determined. The protein content of various wheats, generally termed "soft/spring" or "hard/winter" wheats varies from about 8% to 16%. The softer, spring wheats have the lower protein contents and are best for cake flours. The higher protein content winter wheats are better for baking breads and cost more money than the soft wheats.

As the carloads of wheat came onto the railroad siding adjacent to the mill, a man named Fred Tradell, nick-named "Swede", would scientifically sample the wheat in the cars and send the samples to the chemistry lab to perform the above tests.

In the Kjeldahl analysis for protein content, one could not help spilling a little concentrated sulfuric acid on shoes, lab coats and other clothing. This acid is an effective dehydrator and disintegrates many organic materials including cotton, leather, and paper. Consequently, lab coats and shoes, and other clothing soon get full of holes.

We had one accident that could have been very serious. We had a rack of Kjeldahl flasks hooked up to a pure tin exhaust header so we were making several determinations simultaneously. The tin header had been in use for many years and clogged the exit of one of the flasks. Steam pressure blew the flask off the header. It went just over my head where I was doing some weighings at an analytical balance and crashed to the floor while dripping hot acid throughout its trajectory. Fortunately, none soaked through to my skin but just put some more holes in my lab coat.

Now to "My Flour Mill". The Main mill contained machinery of giant proportions. The flour making machinery was very noisy and you had to talk "mouth- to -ear" to be heard. Huge electric motors on the ground floor turned the wheels of the machines on every floor by means of a multiplicity of round-rope, endless leather belts. The ropes continuously generated high voltage, static electricity just as does a Cockcroft-Walton machine for research in physics. Consequently, electrical bleed-off mechanisms were employed on every floor to discharge any static electricity. As you may know, flour mill dust has blown a mill up on a number of occasions.

Smoking in the mill, and the possession of matches was forbidden. Smokers got around their problem by chewing tobacco. Many a time, I saw tobacco chewers spat a big, juicy load down the bran -shoot, hiding their dastardly deed by the fact that the color of wheat bran and tobacco crud are similar in color.

Within the main mill was "My Flour Mill", a miniature, complete mill in which I could start with wheat and turn it into flour. This was my most enjoyable task.

The Sperry Flour Mill had a testing kitchen and employed a home economist. Her name was Afton McGregor. I made, on a small scale, the particular type of flour for which the mill had orders. Then Afton would use my flour to make breads, cakes, roll, biscuits, and the like. Next she made several physical tests on the products. The final test was in the eating. Those of us in the Chem Lab took care of that matter.

Now that the flour had passed this quality control step, the main mill would gear-up to produce the needed flour in quantity.

My flour mill had all of the components of the big mill and was capable of making any kind of flour that was needed. As an example, I will tell you what it takes to make white flour as well as some principles of bread making.

Only two grains are capable of making good, fermented bread dough; namely, wheat and rye, the latter being inferior to wheat. Corn, rice, beans, potatoes, peas, barley, and various dried, powdered roots and other vegetable products are made into flour-like products but in and of themselves are not good for making a fermented bread.

Wheat, nominally, contains the following:

Starch	65-70%
Proteins	8-16%
Cellulose and fat	1%
Sugars	2.5%
Ash (mineral content)	0.5%
Water	13-15%

Miraculously, these substances are ideal for making a leavened bread by the addition of the microscopic plant that we call yeast. At the proper temperature, yeast grows by ingesting the above materials and, as a waste-product of its metabolism, creates carbon dioxide (the same gas that puts the sting into soda pop). This gas creates the holes that lighten bread, cakes and other products.

Biscuits, pancakes, and some other flour products do not use yeast to make the product rise. Ordinary sodium bi-carbonate and calcium biphosphate, both of which occur naturally as minerals in the earth are added to the flour in the proper proportion to react together in the presence of moisture and heat to produce the carbon dioxide needed to leaven the product.

The steps taken to make white flour are given below:

1. The mixture of wheat types for the desired product; cakes, bread, pasta, pancakes, crackers, etc. are blended.
2. The wheat is cleaned in a machine that uses water, paddles, sieves, and air currents to rid it of weed seeds, dirt, sand, and rocks.
3. The wheat then goes to a machine that adjusts the water content by forced air drying or water spraying (as is required) to obtain a moisture content of 13-15%.
4. Then it passes to the roller mills, most often called "the breaks" by the mill operators. They comprise four consecutive stages in which the wheat passes between corrugated rollers travelling at differing speeds of rotation. This gives a tearing effect to the wheat berries. Grinding is not used. The 1% bran in the wheat exits to the bran chute at this point.
5. Then its off to the reduction rolls which are fluted like tiny gear teeth. They also rotate at different speeds to continue the tearing action on a finer scale.
6. Next comes "bolting". Bolting is sieving by means of metal and silk screens which employ air currents to sieve out the correct flour particle size for the desired end-use.
7. Next, comes bleaching. Flour, left to itself, bleaches naturally by its reaction with the oxygen of the air and makes a better product if it is stored for awhile before using.

Additional bleaching of the flower is obtained by passing chlorine gas or Agene (nitrogen tri-chloride) through the flour. On My Flour Mill, I made the Agene gas by passing chlorine through a solution of ammonia water.

8. Finally, thiamine, riboflavin, niacin, and iron were added to the flour by mandate of the U. S government.

Wheat– the staff of life!

Perhaps God's greatest material gift to his earthly children.

My Flour Mill gave me an unprecedented opportunity to appreciate one aspect of His magnificent goodness.

Dear Lord, we thank thee for our daily bread.