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Inflatable Packers
On the Historical Origins and Development of Packer Technology

Part One: 1800 to 1850

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In our following series of articles on the origins of the inflatable packer and packer technology, somewhat arbitrarily divided into fifty year sections, we will explore in depth and document the development of that essential article for well development, the packer. At Replacement Inflatable Packers and Elements Pty Ltd we manufacture inflatable packers, the development and technology of which is firmly rooted in the twentieth century.

However, inflatable packers are not the only type of packer manufactured today, as the roles of swellable and mechanical packers persist in important niche markets. Nowadays, inflatable packers are available in a great variety of configurations and methods of construction in order to address the many and varied requirements of eventual end users, such tasks as acidizing, leaching, cementing and hydraulic hydrofracturing.
However, it still holds true that the fundamental role of the packer is to isolate or 'pack off' one strata of a borehole from another, and indeed as we shall see, the earliest packers existed solely to prevent the ingress of undesirable upper strata fluids or contaminants from diluting or polluting the desired lower horizon fluids of a well.

The genesis of the modern inflatable packer has its roots firmly in a bygone era, one where industrious, hardworking folk used whatever materials which were on hand or readily available, to fashion such items as might be required to solve or at least ameliorate, problems or difficulties encountered in everyday life.

This era, which we may date as beginning on the eve of the year 1800 CE, was already marked by profound and unfolding political, social and scientific movements. The dawn of the nineteenth century and the following twenty odd years (and not forgetting the proceeding thirty years) were marked by significant events, whose impact is felt to this day.

Consider: the First Industrial Revolution, while underway, particularly in England, was yet to make a significant mark on the lives of ordinary folk. While the powdered wig was now unfashionable, Watts improved steam engine was making an increasing impact on the means and methods of production. James Watts did not invent (as some believe) the steam engine, but improved upon earlier versions in several respects, most significantly by his use of the "stuffing box" a topic which, in relation to packers we shall explore in greater depth in a future article. Watts stuffing box comprised of a seal, or gland, surrounding the engines piston rod, making the engine some seventy five percent more efficient than its forebears, by obeying the first law of Thermodynamics. The Laws of Thermodynamics were unknown, of course, in the year 1800, and would not be adequately framed till another fifty or so years had passed.
The dawn of the nineteenth century was an age still reliant on the winds for sailing ships and windmills, water flow for waterwheels, horses and sheer manpower to provide the motive forces necessary for agriculture, transport and the gathering of raw materials required for the mass production was long away.

The dawn of the nineteenth century and the several decades following witnessed or number of momentous events. Britain incorporated the Kingdom or Ireland into its realm, this becoming the United Kingdom of Britain. On the continent, Napoleon Bonaparte was consolidating his power, crowning himself Emperor of the French in 1804 and ushering in the Napoleonic Wars.

The state of the new century saw many happenings, as well in the newly created United States of America, the War of Independence having ended in 1783. A ere twenty years later, in 1803 the fledgling United States doubled in size with the signing of the historic, Louisiana Purchase and the subsequent expedition of Lewis and Clark. These and many other events were overarched by the second Great Awakening, a religious revival that saw significant growth of the Baptist and Methodist churches, amongst others, as well as the birth of Mormonism in 1830. The first decade of the new century also saw the eight year Presidency of the gifted scholar and polymath, Thomas Jefferson, signer to the declaration of Independence and framer of the Constitution of the United States of America.

It is in the context of the social and political happenings of the new century that we must consider the achievements of two, somewhat more ordinary but nonetheless remarkable men, the Ruffner Brothers, David and Joseph (jnr). In 1806, on the banks of the Kanawha River, in what is now Charleston, West Virginia, on land purchased by their father who had recently deceased, they set to work to extract salt from the earth as a commercial enterprise, salt being an often expensive necessity of life in an age without canned goods or refrigeration.

The Ruffner brothers drilled rather than dug their brine well, considered by historians to be the first drilled well in America and introduced a number of innovations over the course of their project. At this point we shall introduce an historical account of the Ruffner brother achievements, taken from paper written by Dr John. P hale, historiographer, as reproduced by Mr Samuel F. Peckham in his report as a Special Agent for collecting statistics titled " {Production, Technology and Uses of Petroleum and Its Products" written for the department of interior Census as printed by government printing office, Washington, 1884.

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"In order to reach, if possible the bottom of the mire and oozy quicksand through which the salt water flowed they (the Ruffner brothers) provided a straight, well formed, hollow sycamore tree, with 4 feet internal diameter sawed off square at each end. This is technically called a 'gum'. This gum was set upright on the spot selected for sinking, the large end down, and held in its perpendicular position by props or braces on the four sides. A platform, upon which two men could stand, was fixed about the top; then a swape was created having its fulcrum in a forked post set in the ground close by.

A large bucket, made from half of a whiskey barrel, was attached to the end of the swape by a rope, and rope was attached to the end of the pole, to pull down on, to raise the bucket. With one man inside the gum, armed with pick, shovel and crowbar, two men on the platform on top to empty and return the bucket, and three or four to work the swape, the crew and outfit were complete.
After many unexpected difficulties and delays the gum at last reached what seemed to be rock bottom at 13 feet. Upon cutting it with picks and crowbars, however, it proved to be but a shale or curst about 6 inches thick of conglomerated sand, gravel, and iron. Upon breaking through this crust the eater flowed up into the gum more freely than ever, but with less salt.
Discouraged at this result, the Ruffner brothers determined to abandon this gum and sink a well out in the bottom, about 100 yards from the river. This was done encountering, as before, many difficulties and delays. When they had gotten through 45 feet of alluvial deposit they came to the same bed of sand and gravel upon which they had started at the river. To penetrate this they made a 3 ½ inch tube of a 20 foot oak log by boring through it with a long-shanked auger. This tube, sharpened and shod with iron at the bottom, was driven down, pile-driver fashion, through the sand to the solid rock. Through this tube they then let down a glass vial with a string, to catch the salt water for testing.
They were again doomed to disappointment. The water, though slightly brackish, was less than that at the river. They now decided to return to the gum at the river, and , if possible, put it down to the bed-rock. This they finally succeeded in doing, finding the rock at 16 to 17 feet from the surface.
As the bottom of the gum was square and the surface of the rock uneven, the rush of outside water in the gum was very troublesome. By dint of cutting and trimming from one side and the other, however, they were at last gotten nearly to a joint, after which they resorted to thin wedges, which were driven here and there as they would 'do the most good'.
By this means the gum was gotten sufficiently tight to be so bailed out as to determine whether the salt water came up through the rock. This turned out to be the case. The quantity welling up through the rock was extremely small, but the strength was greater than any yet gotten, and this was encouraging. They were anxious to follow it down, but how? They could not blast a hole down there under water; but this idea occurred to them. They knew that rock-blasters drilled their powder holes 2 to 3 feet deep, and they concluded they could, with a longer and larger drill, bore a correspondingly deeper and larger hole. They fixed a long iron drill, with 2 ½ inch chisel bit of steel, and attached the upper end to a spring pole with a rope. In this way the boring went on slowly and tediously, till on the 1st November, 1807 , at 17 feet in the rock, a cavity or fissure was struck, which gave an increased flow of stronger brine.

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This gave new encouragement to bore still further; and so, by welding increasing length of shaft to the drill from time to time, the hole was carried down to 28 feet, where a still larger and stronger supply of salt water was gotten.

Having now sufficient salt water to justify it they decided and commenced to build a salt furnace, but, while building, continued the boring, and on the 15th January, 1808 at 40 feet in the rock and 58 feet from the top of the gum, were rewarded by an ample flow of strong brine for their furnace, and ceased boring.

Now was presented another difficulty; how to get the stronger brine from the bottom of the well, undiluted by the weaker brines and fresh water from above. There was no precedent here; they had to invent, contrive, and construct anew.
A metal tube would naturally suggest itself to them; but there were neither metal tubes, nor sheer metal, nor metal workers, save a home-made blacksmith, in all this region, and to bore wooden tube 40 feet long, and small enough in external diameter to go in the 2 ½ inch hole, was impracticable. What they did do was to whittle out of two long strips of wood two long half tubes of the proper size, and fitting the edges carefully together, wrap the whole from end to end with small twine. This, with a a bag of wrapping near the lower end, to fit as nearly as practicable, water tight, in the 2 1/2inch hole, was cautiously pressed down to its place, and found to answer the purpose perfectly, the brine flowed up freely through the tube into the gum, which was now provided with a water-tight floor or bottom to hold it, and from which it was raised by the simple swape and bucket.

Thus was bored and tubed, rigged and worked the first rock-bored salt-well west of Alleghanies, if not in the United States. The wonder is not that it required eighteen months or more to prepare, bore and complete this well for use, but , rather that it was accomplished at all under the circumstances. In these times, when such a work can be accomplished in as many days as it then required months, previous experience, or traing, without precedents in what they undertook, in a newly settled country, without steam power, machine-shops, skilled mechanics, suitable tools or materials, failure rather than success might reasonable have been predicted***

For interesting facts in this history of the boring of the first well I a indebted to a MS by the late Dr Henry Ruffner, and for personal recollections and traditions I am indebted to General Lewis Ruffner, Isaac Ruffner, W.D. Shrewsberry, Colonel B.H.Smith. Colonel L.I. Woodyard, W.C. Brooks, and others, and my own experience for the last thirty years.***

Other important improvements were gradually made in the manner of boring, tubing and pumping wells etc. The first progress made in tubing, after Ruffner's compound wood –and- wrapping-twine tube, was made by a tinner who had located in Charleston***
He made tin tubes in convenient lengths, and soldered them together as they were put down the well. The refinement of screw joints had not yet come, but followed shortly after, in connection with copper pipes, which soon took the place of tin, and theses are recently giving place to iron.

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In the manner of bagging the wells, that is, in forming a water-tight joint around the tube to shut off the weaker waters above from the stronger below, a simple arrangement, called a 'seed-bag', was fallen upon, which proved very effective, and which has survived to this day, and has been adopted wherever deep boring is done as one of the standard appliances for the purpose for which it is used. This 'seed-bag' is made of buckskin or soft calfskin, sewed up like the sleeve of a coat or leg of a stocking, made 12 to 15 inches long, about the size of the well hole, and open at both ends; this is slipped over the tube and one end securely wrapped over knots placed on the tube to prevent slipping. Some six to eight inches of the bag is the filled with flaxseed, either alone or mixed with powdered gum tragacanth; the other end of the bag is then wrapped like the first, and the tube is ready for the well.
When to their place- and they are put down any depth to hundreds of feet- the seed and gum soon swell from the water they absorb, till a close fit and water-tight joint made "***

Thus, early in the year 1808, the pioneering Ruffner brothers finished making hole and placed their brine well on the pump. With regard to our thesis, two points are immediately apparent. The first is the use of what is called ' the bag' which consisted of a twine wrapping near the lower portion of the Ruffners original wooden production tube and contiguous with it. As Dr Hale notes, this arrangement was to make a seal"...as nearly as practicable, water tight....", the intention being to prevent the heavy brine horizon from becoming diluted by upper strata water and weak brine. The Ruffners practical and effective solution to an anticipated problem marks this arrangement as the first deployment of a packer.

This wrapping, or 'bag' was, as noted functioned to partially block the annulus between the production pipe and the borehole. Then, as upper strata fluids percolated downhole, the bag inevitably swelled to some degree, thereby producing a much more effective seal. Thus, this crude yet effective 'bag' must be considered the world's first packer to be deployed on a production string, around February in the year 1808.

The second point that arises from Dr Hale's account, and as clearly documented by him, was the Ruffners further improvements in production tubing. Unfortunately, the year that the two brothers abandoned their wooden tubing in favour of handmade tin tubing is not given, though it may reasonable be surmised to have occurred sometime between the years 1808 and 1810 at the very latest. With the new, thinner, non porous tubing, the Ruffners had the opportunity and a degree of necessity to rethink the effectiveness of the original 'bag', and contrived their much more effective and easily deployed ' seed bag' as so well described above.

The 'seed bag', the second swellable packer to be conceived of and deployed by the Ruffners, was to remain the template for packer technology for many decades to come. Thus David and Joseph Ruffner (Jnr) were more than pioneering well drillers, but the fathers of packer technology, and whose ingenuity in this regard has all but been forgotten today.

As Mr Charles Hedrick noted in his "History of the Ruffner Family of Kanawha", 1894, their innovations "...greatly increase the quantity of salt and lessened the expense of making it, and the alt makers and public generally were wholly indebted to David Ruffner for those advantages and mainly also for the first boring wells through rock and devising

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means for excluding the fresh from the salt water". Far from the notion that packer technology was an offshoot of oil and gas production in the twentieth century, it was already a developed technology on the banks of the Kanawha River in the year 1810.

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