

# Fire! Fire! Fire!

*James C. Rautio*



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**I**t is 1929. A fire has started in the kitchen. The firemen come, but there is no water. All they can do is help carry furniture out of the house. After the fire fades and the extensive damage becomes apparent, the home is abandoned. Later attempts to preserve the remains fail. Glenlair, home to one of the greatest physicists ever, James Clerk Maxwell, might be lost forever. Figures 1–3 show how it looked during my first visit in July 2005. Depressing.

Society is what it is today because of Maxwell's work, and not just because of his electromagnetic theory, which we today refer to as Maxwell's equations,

but also because of his work on thermodynamics, fluid dynamics, control theory, Saturn's rings, and color perception and color photography. We all owe a great debt to Maxwell. Just on Maxwell's equations, a plethora of successful commercial software companies have been started, exploiting the power and the beauty hidden within Maxwell's electromagnetic theory. I happen to have started and own one of those companies. As I stood there gazing upon the ruins of Glenlair, I could think only one thought, "Something must be done." We owe it to him. In the next several years, with help from my friends, I actually did something.

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In 2007, I approached the IEEE Foundation and the IEEE Microwave Theory and Techniques Society (MTT-S) and I offered to make a large donation if the MTT-S would match it. The MTT-S agreed. The European Microwave Association and the IEEE Antennas and Propagation Society also joined in. Sufficient



**Figure 1.** Maxwell's home, Glenlair, as it appeared during my visit in July 2005. The effects of time are poised to complete the work started by the 1929 fire.

**The good Captain's efforts now ensure that Glenlair House will be in good shape for many generations to come.**

funds were raised, and a full preservation, along with some restoration, was completed over several years. This article is an overview of the preservation and also forms a travel guide for anyone desiring to undertake a Maxwell tour and connect with our intellectual heritage.

The funding that my friends and I provided did not have smooth sailing on its way to Glenlair. Society donations of that size must be approved by the IEEE Board. One board member was complaining that Glenlair was just a pile of rocks and did not deserve funding. Other problems appeared. A good friend of MTT-S, Peter Staecker, was also a board member. He successfully shepherded the funding through the mine field, telling me at one point, "I would live in a shack if that is what it takes to get this through." He succeeded, fortunately without having to live in a shack.



**Figure 2.** Decades of debris had accumulated in the ruins of Glenlair by 2005.



**Figure 3.** In 2005, Glenlair's porch was roofless, doorless, and windowless. A tarp was thrown over the unique tile floor to protect it from the weather.



**Figure 4.** The author and a view of Edinburgh from the top of Arthur's Seat, an ancient volcano. Modern geology was started by James Hutton's studies of, among other areas, Salisbury Crags nearby. Hutton was assisted by Maxwell's great grandfather Sir George Clerk Maxwell, Fourth Baronet. It was Sir George's marriage to Dorthea Maxwell that brought the Maxwell name into the Clerk family. The marriage, and the new last name, also brought along the Glenlair estate.



**Figure 7.** Mary Queen of Scots lived in Stirling Castle for many years. When she was later taken prisoner by Queen Elizabeth I, the Clerks of Aberdeen were forced to flee to Penicuik, just south of Edinburgh, starting the modern Clerk lineage, leading to our own James Clerk Maxwell. On the way there, catch a glimpse of the castle featured in Monty Python and the Holy Grail.



**Figure 5.** Edinburgh Castle, at the west end of the Royal Mile, is built on top of another ancient volcano. The Royal Mile itself slopes gently down to the east (left). The Royal Mile is a "crag and tail" geology, where glaciers left a tail of gravel after encountering the crag (the Scottish spelling is "craig").



**Figure 8.** The author and his wife at St. Andrews, featuring the world's oldest golf course. While there, enjoy a pint at the pub nearby where Kate often met with Harry.



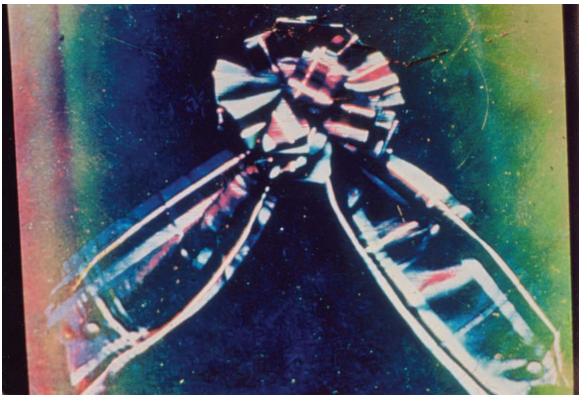
**Figure 6.** Enjoy the spectacular Scottish highlands scenery on the way to Loch Ness. Once you get there, if you are lucky, you might catch a glimpse of "Nessie" herself! (It seems she stops moving whenever someone is watching.)

I think Maxwell's spirit smiled on Peter because he is IEEE president for 2013. In 2012, as IEEE president elect, he and his wife, Susan, asked me if my wife, Jean, and I would like to visit Glenlair together. After giving it an appropriately lengthy consideration, I instantly replied, "Yes!"

If there is a Maxwell pilgrimage in your future, you can arrive at Edinburgh Airport and take a taxi, bus (very convenient), or rental car to a hotel in the general area of Princes Street or near Edinburgh Castle. By train from other areas of the United Kingdom, get off at Waverley Station. Note: Be sure to pronounce the city name, "Ed-in-burr-ah," not, "Ed-in-burg." If you are really good, roll the "r" lightly. For those coming from North America, you will typically arrive in the morning. Hotels can sometimes give access to your room when you arrive. Otherwise, you might want to pay for an



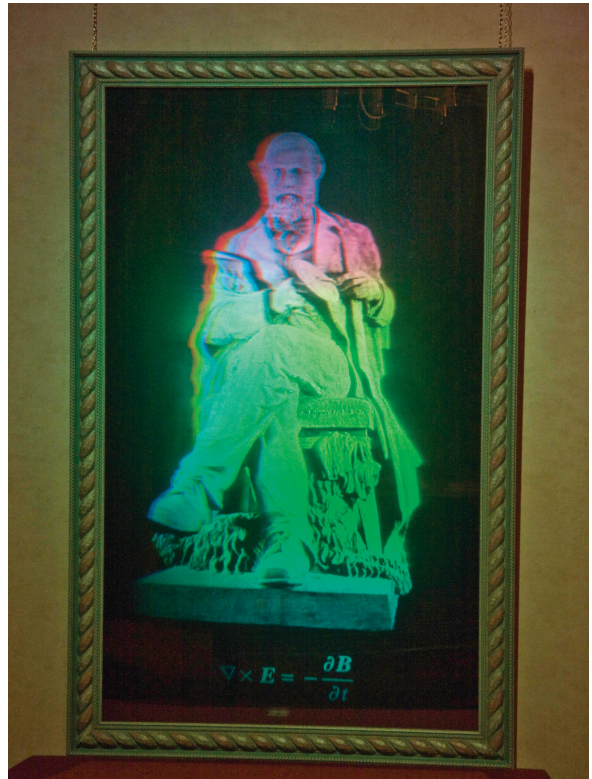
**Figure 9.** The one and only statue honoring Maxwell, here being dedicated in 2008, is in Edinburgh on the east end of George Street. If you are prepared for night photography, the stop lights in back of the statue can backlight the scene in other-worldly primary red and green glows.



**Figure 10.** The world's first color photograph, here recreated from the original negatives, was taken by Maxwell. The subject is his wife's tartan hair ribbon.

extra night up front so you can snooze a bit on arrival. Prepare for weather that tends to be cool and rainy most of the year. Extremes of any kind are rare.

After you get settled, enjoy a tour of the Royal Mile, the Palace of Holyroodhouse, Arthur's Seat (Figure 4), shopping along Princes Street, Edinburgh Castle (Figure 5), and wonderful restaurants and pubs everywhere. Pubs are awesome along Rose Street, adjacent to Princes Street. In case you don't realize it, in a pub you have to go to the bar to place your order. There is no table service. Pub homework assignment: Find out what "bangers and mash" are. (It is more fun if you find out by ordering it instead of googling it!) And, why would they ever be called "bangers"?



**Figure 11.** There is an amazing life-size hologram of the Maxwell statue inside the nearby Royal Society of Edinburgh headquarters.

Walking is very safe and is the perfect way to get around provided you can handle the plentiful hills. Taxis are everywhere. All taxi drivers have memorized all the streets, so if you have an address, you will get there. There is also the usual hop-on, hop-off bus tour (with a main stop close to the Waverley Train Station) and many day trip bus tours throughout Scotland. Loch Ness, Stirling Castle, and St. Andrews (Figures 6–8) are all well worth the time.

When it is time to start our Maxwell tour, a short walk north, up the hill from the Balmoral Hotel (near the Waverley Train Station on Princes Street) brings us to the east end of George Street. George Street is central in what is called "The New Town." The New Town is laid out on a rectangular grid and was built in the early 1800s. Here we have the one and only statue in the world in honor of James Clerk Maxwell (Figure 9), dedicated in 2008 in this prime location. You will want at least a few color photographs. Appropriately, the object Maxwell is holding in his hand is a "color wheel," which he used to quantitatively determine that red, green, and blue are the primary colors of light. Maxwell used that knowledge to create the world's first color photograph (Figure 10). It is an image of a tartan (also known as a Scottish plaid in North America) hair ribbon belonging to his wife. The original negatives, from which this image was created, are on display at the James Clerk Maxwell Foundation [2]. This image is occasionally published upside-down...now you know!



**Figure 12.** Maxwell's mother died when Maxwell was eight years old. Since she was tutoring him, this forced him to move back to Edinburgh to live with his Aunt Isabella Wedderburn and her daughter Jemima. (Photo courtesy of the James Clerk Maxwell Foundation.)



**Figure 13.** Maxwell's cousin Jemima Wedderburn would become a world class painter providing us with many images of young Maxwell. Her husband, Hugh Blackburn, was a professor of mathematics at University of Glasgow, a close friend of Lord Kelvin, and a pioneer in photography.



**Figure 14.** A Jemima painting of herself and young Maxwell "tubbing" in the River Urr, a short walk from Glenlair. (Photo courtesy of the James Clerk Maxwell Foundation.)



**Figure 15.** Miss Jane Cay (left) and her sister, Maxwell's mother, Frances. (Photo courtesy of the James Clerk Maxwell Foundation.)

A full description of the statue and the detailed plinths on the sides is provided in [1]. Before you go, be sure to find out who Toby is.

Next, follow George Street to the west. Just before the first intersection, you'll find the Royal Society of Edinburgh (RSE) [3] on the left. The site of numerous public lectures, both now and in Maxwell's time (he was very active in the RSE), it is well worth a stop. If you go inside, perhaps at one of their public events, be sure to see the amazing life-size hologram of the Maxwell statue inside (Figure 11). Also see how many portraits of scientists you recognize hanging on the walls.



**Figure 16.** A Jemima painting of young Maxwell doing homework at Miss Cay's home, 6 Great Stuart Street. (Photo courtesy of the James Clerk Maxwell Foundation.)



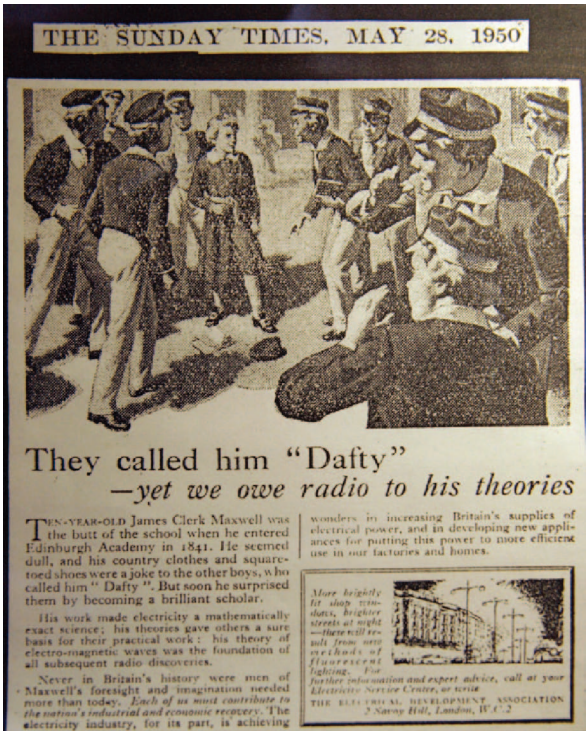
**Figure 17.** Peter and Susan Staecker at the entrance to Maxwell's birth place, 14 India Street, now owned by the James Clerk Maxwell Foundation.



**Figure 18.** David Forfar of the James Clerk Maxwell Foundation, Peter Staecker, and Jean Rautio viewing one of the many Maxwell related exhibits at 14 India Street.



**Figure 19.** Edinburgh Academy as it exists today.



**Figure 20.** A newspaper account recalling Maxwell's first encounter with his new classmates. (Photo courtesy of the James Clerk Maxwell Foundation.)

## Yes, you can walk on the same step and the same tile floor that Maxwell once walked on and open the same door that Maxwell once opened.

Next, get out your map and plot a short course to 31 Herriot Row. This street is named after George Herriot, who worked with James Watt to establish Herriot-Watt University. He always enjoyed playing with coins in his pocket as he walked along and was known as “Jingling George Herriot.” On the way, as you are perhaps jingling coins in your own pocket, you might pass a house with a cranberry red door (#17). This is the home of Robert Louis Stevenson of *Treasure Island* and *The Strange Case of Dr Jekyll and Mr Hyde* fame.

At 31 Herriot Road, we have the home of Maxwell’s Aunt Isabella Wedderburn, his father’s sister, and her daughter, Maxwell’s cousin, Jemima. Maxwell’s mother (Figure 12) died when he was eight years old and, after a failed experiment with a tutor, he came to live here and attended Edinburgh Academy prior to going to the University of Edinburgh. Jemima (Figure 13) was to

become a world class painter specializing in birds and scenes of daily life. We have a number of paintings of Maxwell in his youth. Jemima and James spent many hours together both here and back home in Glenlair (Figure 14).

You might also want to find your way to 6 Great Stuart Street. Young Maxwell spent a lot of time here with his other aunt, Miss Jane Cay (Figure 15), his mother’s sister. Figure 16 shows a Jemima painting of young Maxwell doing homework. If you were to walk in, go all the way to the back and look to your right, that is where young Maxwell would have been. Or at least, that is what I am told. Respecting the privacy of the present inhabitants, I have never knocked on their doors. On your way, notice the cobblestones in some of the streets. I am guessing that these might be the same cobblestones as when young Maxwell walked (or perhaps ran?) eagerly from one aunt’s house to the other. If so, we are walking on the same cobblestones that Maxwell himself trod upon so long ago in the mid 1800s.

On the way to 6 Great Stuart Street, you’ll cross India Street. For the main Maxwell show in Edinburgh, turn right on India Street and proceed to #14 on



**Figure 21.** The Edinburgh Academy recently built the James Clerk Maxwell Science Center.



**Figure 22.** The Lockerbie memorial to PAN AM flight 103 is well worth a few moments. Exhibits at the nearby visitor’s center are moving.



**Figure 23.** From left: Captain Duncan Ferguson, Susan and Peter Staecker, and Angus Ferguson (Duncan’s son) in the restored servant’s quarters of Glenlair.



**Figure 24.** A preserved and partially restored Glenlair, windows, walls, and roof will be standing long into the future.



**Figure 25.** From left: Peter and Susan Staecker and Jean and Jim Rautio in front of Glenlair's porch.



**Figure 26.** The tile floor inside the porch has been nearly perfectly preserved over the years due to the careful efforts of Captain Ferguson. It is interesting that the primary colors that Maxwell quantitatively determined dominate.

the left. This is Maxwell's birth place (Figure 17). It is owned by the James Clerk Maxwell Foundation [2] and contains an incredible museum of Maxwell related artifacts (Figure 18). It is well worth at least a half day and, if you want to dig into detail, an entire day. But call ahead, as it is not open on regular hours. The Foundation is most pleased to host visitors interested in Maxwell.

A bit farther north is Edinburgh Academy (Figure 19). Be sure to get a picture in the "space behind the second classroom," where young Maxwell received a sound beating from his fellow students on his first day of classes (Figure 20). He received this special attention because of his different clothes and different accent. Which classroom is the "second" classroom is not certain

today. Most likely it is in the back of the main building on the right side. In a note of irony, very near the probable location, the Academy has built a new state-of-the-art science lecture hall and laboratory (Figure 21) named after Maxwell. Call ahead and perhaps they can provide a tour.

Maxwell is not nearly as well known among the general public as his peers in the history of physics, Einstein and Newton. The many and increasing number of Maxwell enthusiasts are actively changing that. To take the "pulse" of how our efforts are succeeding, I like to ask people in Edinburgh, first, if they have heard of "The Stig" (a popular character on the BBC show, *Top Gear*). They always reply something like, "Of course, are you daft?" Then I ask if they have



**Figure 27.** IEEE Foundation President Dick Gowen and 2009 IEEE President John Vig inside the Glenlair porch at the unveiling of the IEEE Milestone Plaque honoring Maxwell's electromagnetic theory.



**Figure 28.** This beautiful pastoral view from Glenlair is still very similar to what Maxwell would have enjoyed.

ever heard of Maxwell. Our taxi driver on my last visit replied, “Doesn’t he have a new statue on George Street?” Yes, it is working!

My most memorable answer occurred when we were invited to dinner by Prof. Jason Hong (Herriot-Watt University) at the Balmoral Hotel, very fancy, right next to the Waverly Train Station. (A famous *Top Gear* race ended at this hotel, in fact almost in the very spot where we sat for dinner!) I asked our pretty young server about Maxwell and she replied, “Of course I’ve heard of James Clerk Maxwell.” She noted my surprise, and then added, “I’m an electrical engineering student at the University of Edinburgh.” Made my day!

Next stop, Glenlair. Take my advice. Get a GPS. Even if you hire a driver for the day you still need a GPS. I can almost guarantee you or your hired professional driver, does not matter, will get lost. The roads are complicated. I have been there four times. The only time we did not need a GPS was when we took a train halfway there, to Lockerbie, and then the owner of Glenlair, Duncan Ferguson, picked us up. [By the way, Lockerbie, site of the PAN AM flight 103 terrorist attack, is well worth a



**Figure 30.** The author’s son, Brian, and Captain Ferguson’s dog, Toby, swimming in the River Urr. The bridge was built by Maxwell’s engineer cousin William Dyce Cay in 1861–1862.

memorable several hour stop (Figure 22). Ask the locals where to go.]

On this trip, Peter rented a car. Peter is a brave fellow. For some reason, we must make a special effort to drive on the other side of the road and to go around the numerous traffic circles in the opposite direction from what we are used to. And who is it that has the right-of-way for exiting a two-lane traffic circle? Peter knows these things. Be sure you know before you go. And then most rental cars are standard shift. So we have to use our left hand to shift. On top of that the roads tend to be narrow with no shoulders and no ditches. Takes some getting used to. At least we can read the signs!

Turns out, “Take the third exit from the traffic circle,” does not always have a unique and clear solution, so we did end up taking a scenic route. And it was indeed scenic, the Scottish countryside is gorgeous, even with the rain. When we arrived, Duncan gave us a tour of the preserved and partially restored Glenlair.



**Figure 29.** A recreated star-shaped finial (decoration at the top of a roof peak) suggests Maxwell’s interest in astronomy. The original construction also supported a crescent moon-shaped finial.



**Figure 31.** The Glenlair Burn, a small tributary to the River Urr is close by Glenlair and was also a likely swimming site.



**Figure 32.** Sign in a restaurant parking lot suggests the nature of British in-law courtesy.



**Figure 33.** Another parking lot sign carries astounding news.

Capt. Duncan Ferguson (Figure 23), retired from the Royal Navy, is the present owner of Glenlair. The portion of Glenlair that was added by Maxwell in the 1860s, now known as “Glenlair House,” is owned by the Maxwell at Glenlair Foundation and has been the subject of our recent attention. The good Captain’s efforts now ensure that Glenlair House will be in good shape for many generations to come.

The original roof over the main section was still standing, but sagging, when we started. Enough rot was found that we had to completely replace the underlying rafters. The slate shingles were carefully placed to the side and then replaced on the roof when the rafters were complete. It looks like they had never been removed (Figure 24).

The cool and damp Scottish climate tends to wear away the mortar that holds the stones of the stone walls in place. All of the missing mortar has been replaced. This is called “repointing.” The original roof on the porch had been lost. That too has been replaced. The porch (Figure 25) now houses a small visitor’s center;



**Figure 34.** Into the ditch!

the interested visitor can easily spend 20–30 minutes here. Note especially the tile floor, designed by Maxwell. The tiles are colored white, red, green, and blue (Figure 26). Yes, there are three distinct red-related shades (red, maroon, and goldenrod), but I sometimes wonder if Maxwell selected these colors because he knew red, green, and blue are the primary colors of light, all adding together to yield white. Don’t forget to note the IEEE Milestone plaque on prominent display (Figure 27).

The door to the porch is the original door Maxwell used. It had been removed and carefully preserved by Duncan over the years and is now back in place. Of the steps into the porch, the top step is original, the others were relocated from the garden in back of Glenlair. So, yes, you can walk on the same step and the same tile floor that Maxwell once walked on and open the same door that Maxwell once opened.

The window frames have all been restored and windows put in place. Special care is needed in replacing the lintels (the top portion of a window frame) to keep unsupported rock in the wall above from collapsing right after the old lintel has been removed.

Maxwell put this portion of Glenlair in place in the 1860s. He published his seminal “A Treatise on Electricity and Magnetism” in 1873. While working equations, it is nice to sometimes daydream and look out the window. Perhaps Maxwell would let his gaze wander out these windows as dancing visions of, who knows, perhaps displacement current might magically appear in his mind, to the benefit of all humankind. Figure 28 shows the idyllic view he would have had.

Numerous finials (the decoration at the ends of the roof peaks, etc.) have been recreated and put in place. Figure 29 hints at Maxwell’s interest in astronomy. Maxwell had actually predicted mathematically that Saturn’s rings must be composed of thousands of tiny moon-lets, long before any spacecraft had visited.

## Maxwell visitors to Glenlair are always welcome, but please call ahead.

Maxwell often went swimming, sometimes in the River Urr (Figure 30) and sometimes in its tributary, the Glenlair Burn (Figure 31), both a very short walk from the House. Duncan found that he has to occasionally firmly advise modern swimmers that swimsuits should be used. We are uncertain about what the custom was in Maxwell's day. Oh, and the water is very cold.

Maxwell visitors to Glenlair are always welcome, but please call ahead.

While at Glenlair, we took Duncan and his wife, Henrietta, out to dinner at a local restaurant. Signs in the parking lot show classic British humor (Figures 32 and 33). On the way back, we were following Duncan, but we lagged behind, enjoying the scenery. Unknown to us, our GPS was taking us to Nether Glenlair. We got

lost. Dark clouds began to gather. The road got really narrow. The only thing missing was a wolf howling in the distance. Suddenly a Royal Mail truck appeared from around a blind curve out of nowhere! Swerve to the edge! Ker-chunk go both left wheels into a very deep narrow ditch (the only one we ever saw in Scotland), which had been hidden by tall grass. Screech! Our car comes to a complete stop (Figure 34).

We were stuck, lost in the middle of nowhere. The mail truck driver got out, apologized, and then complained that he hated these narrow Scottish roads. He proudly added that he was from Wales. He tried to help out, but nothing worked. Finally, I called Angus Ferguson, Duncan's son. He came over with his Land Rover and two beautiful little girls, who had the biggest thrill helping these silly Americans who got stuck in their Scottish ditch (Figures 35 and 36).

Back at Glenlair, Angus got out a power washer and cleaned the mud off our car. Duncan later asked which power washer he used. "Good," he replied to Angus' answer, "The other one would have taken the paint off!" Anyway, amazingly, not a scratch anywhere. Lucky day, I guess.

Angus is the future of Glenlair. He is currently planning the renovation of the original part of Glenlair, built by Maxwell's father, as a private residence. It will be wonderful if the entire building can be preserved. There are presently no floors inside Glenlair House; we have preserved and restored only the roof and walls. Perhaps someday, if we can find funding, we can put floors in Glenlair House as well.

There is much more to Glenlair, including Maxwell's grave site nearby, which I have not described. I shall leave this as homework for the enthusiastic Maxwell student. You can explore more photographs of the various sites at [4]. There is a lot of fine detail about Glenlair at Captain Ferguson's Web site [5].

The several places in Edinburgh and Glenlair that I have described are electromagnetic holy sites. If you have spent your life building on Maxwell's work, you would do well to place a Maxwell pilgrimage prominently on your life list. It's the least we can do for this great person who has done so much for us.

## References

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**Figure 35.** Angus Ferguson (in red) and his two young ladies prepare to attach the tow rope.



**Figure 36.** Out we go!

