1,001 metres: planned height of tower at centre of Kuwait's Madinat al Hareer development.

The Empire State Building under construction.

Sky High

Man's fascination with tall buildings has evolved since the 146-metre-high Great Pyramid went up at Giza 4,500 years ago.

Large-scale structures of yesteryear were mostly built out of heavy stone with load-bearing walls, so that when they got taller, the walls had to get thicker. But two significant inventions in the mid-1800s allowed the modern skyscraper to take form. The first was the Bessemer converter, a device that used blasts of air to blow carbon out of crude iron resulting in durable, inexpensive steel. Once architects had girders to work with, buildings could be designed with steel cages at their core, removing the load from the walls so structures could rise higher than before.

The second invention was the elevator. Early steam lifts were unsafe; a snapped cable could send them - and their cargo - crashing to earth. But in 1853, American inventor Elisha Graves Otis developed a system that would brace the lift compartment against notched supports should its cable fail, creating a safe and practical way to ascend.

Thanks to these two developments, the "father of the skyscraper" was born. In 1885, construction was completed on the 10-storey, 42-metre-tall Home Insurance Building in Chicago. The steel used to build it weighed one-third of what would have been required had stone been used. The race for the sky was on.

Hot off the blocks in 1913 was the Woolworth Building in New York City, which rose 241 metres into the sky. The "Cathedral of Commerce" cost some US$13.5 million (about US$300 million in today's money), largely due to the extensive foundations and wind-bracing requirements necessary for such a slender tower. But when the 85-floor, 381-metre Empire State Building came along in 1931 it broke every record in the book. Its base alone covered just under 8,100 square metres, and it was built using 54,500 tonnes of structural steel, 10 million bricks and employed 3,500 workers at its peak.

Today's kings of the skies stand tall on the other side of the world. At 452 metres, Kuala Lumpur's Petronas Towers are the world's tallest twin structures, but the Taipei 101 in Taiwan trumps them. Finished in 2003, it is 509 metres tall and can sway 1.5 metres in any direction. It is bedded on 380 concrete piles drilled 80 metres deep, which helps with stability, but it's the 101's tuned mass damper that counters the propensity of such a huge tower to sway. Suspended from levels 92 to 88, the damper acts like a giant pendulum that swings in the opposite direction to the building's sway.

As architects and engineers overcome obstacles in their race to build ever taller, structural engineering evolves in leaps and bounds. Judging by today's giants, the sky's the limit. ■

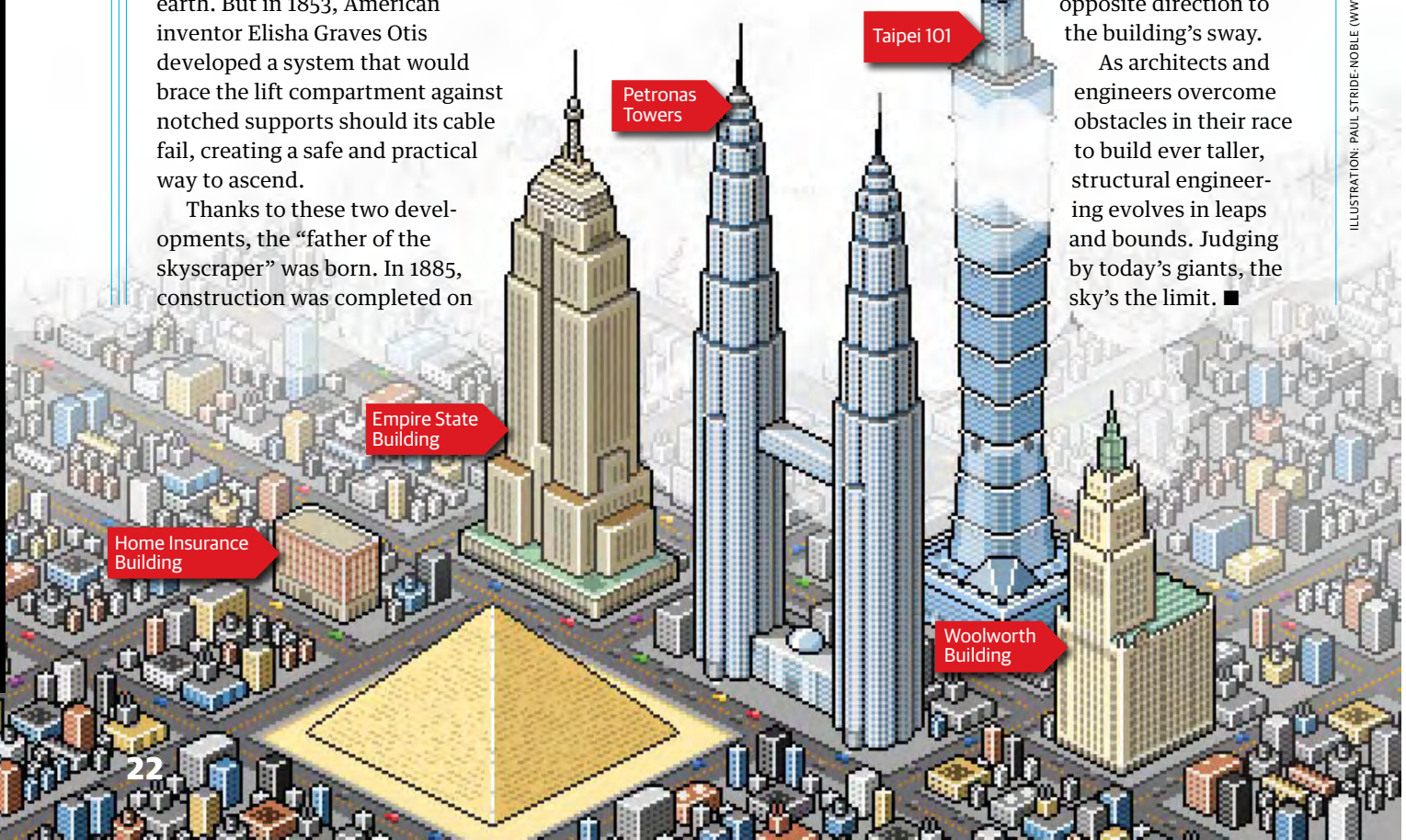

ILLUSTRATION: PAUL STRIDE-NOBLE (WWW.S-ND.COM); PHOTO: GETTY IMAGES