Photographing war: 150 years of conflict in Tate Modern's new exhibition

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According to the photographer Edward Steichen, "the mission of photography is to explain man to man and each man to himself". It's a great definition of an art form that is still, in some ways, in its infancy. In a year that has been infused with stories and memories of war, the Tate's photography show enters the debate with its thought-provoking photographic response to areas of conflict.

Simon Baker, Tate Modern's curator of photography, takes his inspiration mainly from two sources: the American writer Kurt Vonnegut and Hiroshima. Why? Vonnegut took nearly 25 years to respond to his experience of being a prisoner during the firebombing of Dresden in 1945; incarcerated as a prisoner of war he emerged the next day to see what he called "possibly the world's most beautiful city" completely destroyed. Hiroshima, because Baker says that it has inspired works spanning many years.

When Vonnegut published Slaughterhouse-Five in 1969 he said: "I've finished my war book now – the next one is going to be fun. This one is a failure and had to be, since it was written by a pillar of salt." It is in the spirit of Lot's wife that Baker has taken the decision to make "looking back" at events, across a distance of time, the central argument and the organisational basis of this show.

That is not to say that all the works are removed by decades of insulation. Toshio Fukada's mushroom clouds were photographed less then 20 minutes after the Americans dropped their bomb over Hiroshima. A 17-year-old student at the time, Fukada was shielded by Hijiyama Hill. These potent images with their evil beauty still have the power to terrify in their roiling ordinariness.

Baker decided to distance himself as much as possible from photojournalism, wanting to focus on the artists' impressions. The exception is Don McCullin, whose Shell Shocked US Marine, Hue, Vietnam (1968) is shown here, a gruelling portrait revealing the personal toll of war. McCullin appears several times in this show, which traces his transformation from being "merely" a photojournalist in Vietnam, working for Time magazine, to his first overseas assignment in Berlin, when, with a camera purchased by his mother in a pawnshop, he traced the effects on the inhabitants of living with the hardware of war. The last piece that the viewer sees leaving the exhibition is Battlefields of the Somme (2000), McCullin's large vinyl of a beautiful, empty landscape, the road leading into infinity – referring to the 100th anniversary of the start of the First World War.

Baker tells me that one of his triumphs of the show was to convince the Japanese artist Kikuji Kawada to show The Map (1965) in its entirety, a series of prints published exactly 20 years after Hiroshima. It contains images from close to the explosion, taken regularly between 1945 and 1965. Baker points out that Kawada would have been angry when taking them, but that time, as in many cases, has transformed the images into a wall of contemplation.

More recent conflicts are chronicled here. One of the most powerful rooms is by Sophie Ristelhueber; Fait (1992) was photographed seven months after the end of the first Gulf war. Using different perspectives to photograph a desert "transformed" by war, it is all about scars and traces. The prints mounted around us are aesthetically pleasing, yet powerful, from abstracted patterns of the land to details of the detritus of war. What appears to be a Leica camera is, on closer inspection, a tank on its side. The remnants remind us how war changes landscape.

This is a recurrent theme in the show. Paul Virilio's studies show how the beaches of northern France were forever altered by concrete fortifications; a poignant photograph by Marc Vaux from 1920, taken where he was injured in the First World War, a simple X marking the exact spot, has careful lines to demarcate how the landscape had already changed.

But it is not just the big wars that are included here. Susan Meiselas's unforgettable image from Esteli, Nicaragua,
Sandinistas at the Wall of the National Guard Headquarters (1979), shows a Sandinista warrior throwing a Molotov cocktail. In Terreno Ocupado (2007) Jo Ratcliffe captures images of the aftermath of the Angolan civil war, focusing on the acceptance necessary for survival, the quasi-normality of living contrasted with the trauma; one shows a laundry line with crisp white uniforms hanging above the dusty devastation of their surroundings.

Baker is uncompromising in using the photographic medium and unflinchingly embraces a monochromatic palette. It therefore comes as a relief to enter a room of the American photographer Stephen Shore, whose colourful series Ukraine (2012–13) chronicled survivors of the holocaust and their belongings.

Their simple possessions – a pink plastic radio, a large samovar, simple chipped enamel pots, bowls of potatoes – are testament to Shore's words that "I had never photographed content as charged as this before". Baker has chosen to hang them as "clouds" of images, clumped together, a simple caption of the "sitter" their only labelling.

Near to this room is another change from the monochrome starkness. The installation A Guide for the Protection of the Public in Peacetime is at first glimpse chaotic, but upon inspection it contains some of the most celebrated images of the exhibition: Frank Capa's grainy, shaky images of "being there", and a photograph by David E Scherman of the intrepid photographer Lee Miller relaxing in the bath. On the wall a case of horses' hooves shows the different ways horses are shod in times of war – a symptom of impending conflict.

Another contrast to the stern monochrome is The Press Conference. June 9, 2008. The Day Nobody Died (2008) by the contemporary artists Adam Broomberg and Oliver Chanarin. This inventive work is their reaction to having gone to the Helmand province of Afghanistan during what proved to be one of the bloodiest weeks in the conflict, sans camera, "armed" solely with a roll of photographic paper. They unrolled it to six metres and exposed it to the sun for 20 seconds, creating an abstract work redolent of place in its title and substance.

Luc Delahaye, a contemporary artist, has several works in this show, including Patio civil, cementerio San Rafael, Malaga (2009). This large print chronicles the exhumation of a mass grave; one skeleton, hands tied together, bears a coincidental resemblance to a person at prayer. Beauty in terribleness.

Baker has included many women in his list of 50 or so artists. One of the most abiding images is Agata Madejska's 25–36 (2010), its dates referring to how long it took to construct a vast war memorial, more then twice the length of the conflict. Its abstraction masks the improbability of its scale, leaving, as many of the works in this show do, the traces of war, even in the monuments left behind.

There is little relief from the stark depictions of this exhibition. But I left feeling I know more about my fellow men and women, and perhaps myself, through my responses. In his organisation of time, Baker has been able to focus on the long-term effects – the scars – of conflict. He has managed to show some artists, such as Stephen Shore, at their best, both in scale and subject matter. And it is exciting to see a series of black and white works by the Japanese artist Nobuyoshi Araki, best known for his pornographic images of bondage. These might be easy to overlook, so modest is their subject – the sky. Tokyo Radiation August 6–15th (2010), date marked in the corner, is a skyscape from his balcony. Araki was receiving radiation treatment for cancer and said that every morning he "looked at the sky from where the bombs came”. "Other people brush their teeth, I brush my eyes," he said. This is an exhibition to linger in, chew upon, contemplate; an exhibition to make you brush up your eyes.

Conflict-Time-Photography, Tate Modern (020 7887 8888) to 15 March