China's battle against escalating environmental pollution

China's substantial investment and progress to boost science has been highlighted in the *Current Science* editorial 'The Winds of Change'[1]. We would like to add that China has also launched an ambitious battle to overcome environmental pollution in recent years, to improve the quality of life of its people. The consequences of economic growth and development, leading to environmental pollution in the most populous nations such as India and China, have been alarming over the last few decades. Nonetheless, people in China are seriously concerned about the pollution threats. A survey conducted by the All-China Federation on Environmental Protection showed that 94.9% of the people regarded environmental pollution as a serious issue [2]. What is interesting is that as many as 45.7% of the people felt that the trend should be reversed quickly, even if it costs slowing down the country's economic development! The survey was conducted to record public opinion for drafting China's Eleventh Five-Year Plan (2006–10). Also, China's Deputy Minister for Environment, Pan Yue, recently admitted in an interview that the environmental pollution is massive. He added that in Beijing alone, 70 to 80% of the deadly cancer cases are related to environment pollution, with lung cancer leading the death toll[3].

China has evolved from an agricultural backwater to a global economic giant over the last few decades, at the cost of environmental degradation. Majority of rivers flowing through cities are heavily polluted, and about 300 million people in rural areas have no access to clean water. China's water shortage is steadily increasing from 30 to 40 billion m^3 a year, frightening public health and economic prosperity. Water contamination is so serious in China's longest river, the Yangtze, which is jeopardizing the survival of the world's rarest white-flag dolphins[4,5]. Rising pollution levels, dam-building activities and over-fishing in the Yangtze have caused the dolphin population to drop from 400 in the 1980s to less than 100 today. These archaic species have lived on our planet for over 25 million years – they may be destined to vanish in the wild due to man-made pollution.

Despite China's increased spending on environmental protection accounting for 1.3% of the nation's gross domestic product in 2004, 96.6% of the people surveyed believed that more funds should be allocated for the environment. About 97.5% expressed that the promotion of government officials ought to take into account their efforts in protecting the environment. About 80.5% demanded that the government resolve the issue of air pollution, while 91.8% blamed emission from automobiles for increasing urban air pollution. The issue of water safety closely followed that of air pollution, with 97.2% expressing that public opinion should be heard when government agencies make decisions on environmental protection. Interestingly, 92.9% showed even a motivation to serve as volunteers to fight for environmental protection.

China leads the world as the second largest polluter of energy-related carbon dioxide (12.7%) after the United States of America, and its share of world carbon emissions is expected to reach up to 17.8% by 2025. Under the United Nations Convention on Climate Change, China is a non-Annex I country. It means that China has not agreed to the binding emissions reduction in the Kyoto Protocol, which it ratified in August 2002. Although China's direct economic loss due to pollution reached the highest in 2000 and then decreased, the government investment in pollution treatment indeed has increased annually and reached USD 20 billion in 2003 (Figure 1). The area under reforestation also increased from 2001 to 2003. The area under nature reserves had similar increase, which shows that China is trying to restore natural habitats swiftly (Figure 1). Waste gas and sulphur dioxide emission as well as the coal and crude oil consumption increased gradually (Figure 1) to meet China's mushrooming appetite for energy, that has ultimately pushed the world crude oil price to record high levels. Thus China is desperate for alternatives and new sources for energy supply – ethanol and biofuels are increasingly seen as viable substitutes for petroleum.

In an effort to reduce air pollution in China, the city governments of Shanghai and Guangzhou plan to ban use of polluting motorcycles altogether, to coerce people to use public transportation. In the capital city Beijing, the subway and light rail systems are being expanded ahead of the forthcoming Olympic Games in 2008. Battery-operated motorcycles are becom-

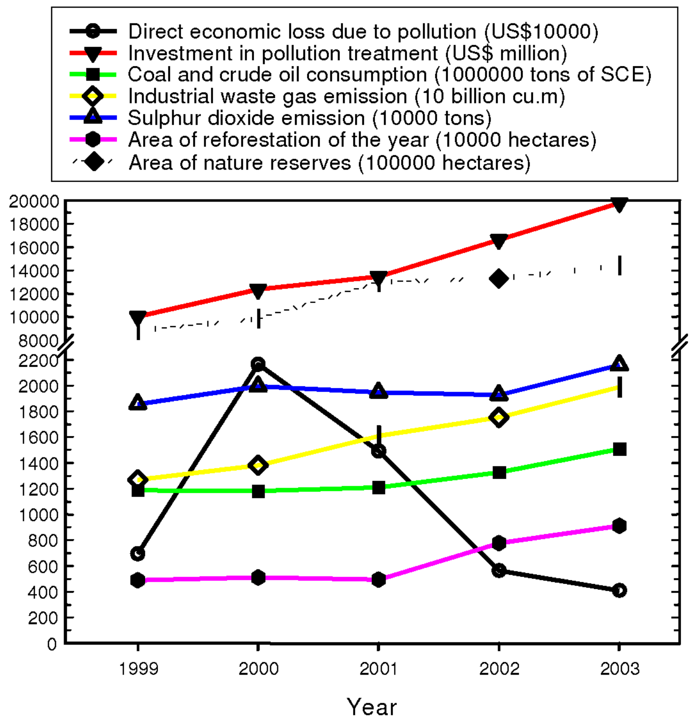

Figure 1. China's environmental protection trend from 1999 to 2003 (Source: Data pooled from the National Bureau of Statistics of China, *China Statistical Yearbook 2004*).

ing common nowadays. In 1999, the city government ordered all vehicles to convert to liquefied petroleum gas and natural gas. By 2002, Beijing had the largest fleet of natural gas buses in the world – a total of 1630 vehicles. As a matter of fact, India attempted to enforce this ahead of China, when India's Supreme Court issued a ruling in 1998 requiring all the city buses in New Delhi to be run on compressed natural gas by 31 March 2001. But only 200 buses were ready by the deadline. Public protests, riots and commuter chaos forced a gradual phase out of the existing 12,000 diesel bus fleet. New Delhi's airborne particulate matter has been registered at levels over ten times of the legal limit and automobiles have been blamed as the prime source of pollution, with more than three million cars, trucks, buses, taxis, and rickshaws often crowding the city streets. India's increasing urban pollution problems are not due to absence of sound environmental policies but due to the lack of enforcement at the local level. Therefore, sweeping measures and public awareness are certainly necessary to tackle pollution in major cities across India. The strategies that are being tested out in the neighbouring China, including higher government spending to tackle pollution, could be pursued in India to combat the choking pollution hazards of the 21st century.

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RESEARCH NEWS

Recent revisions to the geologic time scale

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Dividing 4.5 billion years (b.y.) of earth's geological history into relevant time intervals having global reference or correlation potential has continued to remain an unsettled issue since the times of early geologists like James Hutton (1795) and Charles Lyell (1800). Quite a few methods to achieve geologic time units are on record and over the years a maze of terms have come into use to qualify a specific geologic time, some based on rock successions or stratigraphy (e.g. systems, series, stages), and others based on incidence of important events (e.g. eons, eras, periods, epochs, ages). Also, ambiguous prefixes were used like early-, mid- or late-, or upper-, or lower-, to describe geological intervals. Yet, the divisions marking the stages in the earth's history remained unsatisfactory. For example, the relatively small Phanerozoic time period, covering the last ~ 570 million years, is well divided into 3 major divisions and 16 sub-divisions made easy by abundant paleontological data available. But the vast Precambrian, stretching for nearly 4 billion years, is divided into only two major divisions – Proterozoic and Archaean, a deficiency, neglected till late twentieth century, and surprisingly incomplete even today.

The setting up of the International Union of Geological Congress (IUGS) in the 1960s, saw the commencement of global efforts to correct the distorted state of geologic time divisions. A network of laboratories using uniform investigative procedures took up the task of providing geological data having good acceptability in all aspects. The International Commission on Stratigraphy (ICS) that was set up subsequently organized a few subcommissions which were entrusted with the task of compiling and maintaining stratigraphical database to unify regional nomenclature, update results from new multidisciplinary methods and also to define and classify the terminologies. As a result, the geologic time scale gradually began to present more relevant and reliable divisions of globally applicable stratigraphic units. The revisions put out in the years 1982, 1989 and 2000 are notable, in this connection, though they are not totally complete or perfect[1–3].

In the last two decades alone, developments in field and laboratory techniques, advances in radiogenic and stable isotope studies, improved assessment of fossil records, use of the evidences of earth's magnetic reversals and climatic cycles preserved in sedimentary beds for dating purposes, have all enhanced the quality of data and contributed much to fine-tune the international chrono-stratigraphical scale, introduce new subdivisions and to fix geologic stage boundaries. Synthesizing the major contributions arising from these new approaches, the ICS-Meeting in 2004, headed by F. M. Gradstein, University of Oslo, along with 38 other specialists, discussed the revisions emerging from the fresh data and brought out the latest version of the Geologic Time Scale[4,5], GTS 2004 (Figure 1).

In their revisions to the GTS, Gradstein's team selected from among several of the methods available to construct the geologic time scale, the ones that could provide reliable information for the construction. For example, new seafloor spreading data calibrated through combined application of geomagnetic polarity time scale (GPTS) and $^{40}Ar/^{39}Ar$ dating were applied to fix some of the time boundaries, e.g. Jurassic – Cretaceous, Cretaceous – Cenozoic. Likewise, astronomical tuning of sedimentary cycles influenced by earth's changes in its eccentricity, obliquity and precession (orbital tuning), considered accurate to within ~ 20 K yr, were used to fix Mesozoic subdivisions (Cretaceous,