immune regulation". As often happens in biology, both the mechanisms and the efficient induction of the inhibitory processes underlying this type of immunotherapy are still unclear, with ongoing research providing challenges and new perspectives that are driving the development of monoclonal antibodies against additional targets.

Monoclonal antibodies are also being developed to control infectious diseases – following the concept of protective antibodies that goes back to von Behring and Kitasato. Prevalent diseases such as malaria, influenza and AIDS call for the development of what are termed broadly neutralizing monoclonal antibodies, which, applied individually or in cocktails, might provide broad protection[8].

Intensive work in this direction has yielded promising results, including engineering antibody specificity through the substitution of variable domains by ligand-binding domains from non-antibody receptors[9]. Yet the immune system itself uses similar tricks[10] and, by and large, antibody design is still unable to outdo it in terms of generating and selecting antibody specificities[11]. Nevertheless, the manifold modern molecular, cellular and genetic approaches to selecting and engineering antibodies have had, and continue to have, a tremendous impact on the field, whether by producing partly or fully human antibodies of different classes, making bi-specific or toxin-conjugated antibodies for specific therapeutic purposes, or incorporating antibody variable regions into chimaeric antigen receptors on T cells for use in an anticancer treatment called CAR-T cell therapy.

Monoclonal antibodies are nowadays often generated by isolating or transforming antibody-producing cells taken directly from immunized animals or patients, and transplanting the antibody-encoding genes of these cells into suitable producer cell lines, rather than using hybridoma technology[12–14]. But they started their spectacular career in 1975, secreted by hybridoma cells in Köhler and Milstein's SRBC-containing agar plates.

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Materials science

The nano-revolution spawned by carbon

Pulickel M. Ajayan

In 1985, scientists reported the discovery of the cage-like carbon molecule C_{60}. The finding paved the way for materials such as graphene and carbon nanotubes, and was a landmark in the emergence of nanotechnology.

The history of the carbon molecule C_{60} highlights the fact that discoveries do not happen in a predefined sequence. C_{60}, carbon nanotubes and graphene (single layers of graphite) are essentially members of the same family: all are nanoscale structures that consist of carbon atoms arranged in a periodic crystal lattice. Graphite has been known for a few hundred years, and individual layers of the material could be separated easily. However, the identification of C_{60} by Kroto *et al.*[1] did not occur until 1985. This, in turn, led to the discovery of graphene nearly two decades later[2]. Both of these breakthroughs led to Nobel prizes, in chemistry for C_{60} (1996) and in physics for graphene (2010).

The discovery of C_{60} occurred on the campus of Rice University in Houston, Texas. Eiji Osawa, a Japanese theoretical chemist, had predicted[3] the stable structure of a 60-atom carbon molecule in 1970, but this finding did not come to the attention of the mainstream scientific community. Experimental results from mass spectrometry were also beginning to emerge, showing the stability of 60-atom carbon clusters. However, no one made the connection that these clusters would have the structure that Osawa had predicted. It

150 years ago

Aphorisms by Goethe — the opening article of the first issue of *Nature*, 4 November 1869.

Nature! We are surrounded and embraced by her: powerless to separate ourselves from her, and powerless to penetrate beyond her. Without asking, or warning, she snatches us up into her circling dance, and whirls us on until we are tired, and drop from her arms. She is ever shaping new forms: what is, has never yet been; what has been, comes not again. Everything is new, and yet nought but the old …
So far Goethe.

When my friend, the Editor of NATURE, asked me to write an opening article for his first number, there came into my mind this wonderful rhapsody on "Nature", which has been a delight to me from my youth up. It seemed to me that no more fitting preface could be put before a Journal, which aims to mirror the progress of that fashioning by Nature of a picture of herself, in the mind of man, which we call the progress of Science.

[*In a letter to Chancellor von Müller*] Goethe says, that about the date of this composition of "Nature" he was chiefly occupied with comparative anatomy; and in 1786, gave himself incredible trouble to get other people to take an interest in his discovery, that man has a intermaxillary bone. After that he went on to the metamorphosis of plants; and to the theory of the skull; and, at length, had the pleasure of his work being taken up by German naturalists. The letter ends thus :—"If we consider the high achievements by which all the phenomena of Nature have been gradually linked together in the human mind … we shall, not without a smile … rejoice in the progress of fifty years."…

When another half-century has passed, curious readers of the back numbers of NATURE will probably look on *our* best, "not without a smile;" and, it may be, that long after the theories of the philosophers whose achievements are recorded in these pages, are obsolete, the vision of the poet will remain as a truthful and efficient symbol of the wonder and the mystery of Nature.

T. H. Huxley