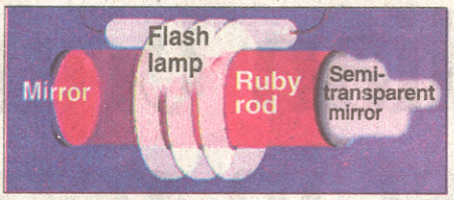

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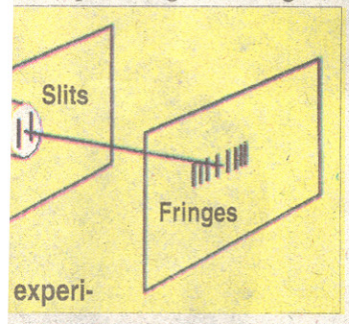
Photon history

The laser, of course is the culmination of our understanding of light itself. *Timeline* published by *Nature* describes the early debates that favoured a corpuscular theory of light, mainly because light moved in straight lines. The classic work of Christiaan Huygens, to explain light in the form of waves, could not prevail over the champions of the corpuscular theory, the greatest being Isaac Newton. In his *Optics* of 1704, Newton considered that the colour of light should correspond to the mass or the velocity of the particles, which also helped explain the splitting of colours when refracted through a prism.

The experiment of Thomas Young in the early 1800s, where light passing through two narrow slits produces a series of dark and bright fringes, may be a turning point towards the wave theory. Augustin-Jean Fresnel's work on diffraction, soon after, resurrected Huygen's first theory, and when, in 1821, he showed that polarisation was explained if light were a transverse wave, Newton was supplanted.

Clerk Maxwell's elegant mathematical structure, to explain all optical phenomena and even predict the existence of electromagnetic waves, seemed to place the wave theory of light as the last word. But again, the distribution of radiation from a warm object over different wavelengths ran into serious difficulties with the wave theory. New kinds of radiation, like X-rays and Alpha rays had been discovered and atoms that emitted light of specific colours were found to have a structure that played a role.



experi-

The result was the discovery of the photon, or the quantum of energy, radiated as electromagnetic waves, which Max Plank showed exactly described black body radiation. This also explained curious phenomena like the photoelectric effect (Albert Einstein got the Nobel prize for this).

The corpuscular theory seemed to be back — but with a difference — so that even "real" particles like electrons were found to have "wave-like" properties. The result was the new field of quantum mechanics which has now been validated in every possible way and verified to incredibly accurate limits. And the result is the laser, the transistor, all kinds of solid state devices, nanotechnology, atomic energy, theories of how the universe began...

It was Einstein who was not finally fully convinced that quantum mechanics, which uses *probabilities and uncertainties* in its

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Red menace

And India's on the threatened route

Ug99, a deadly fungus, causes stem rust on wheat crops that threatens food security in developing countries.

FIRST discovered in Uganda 12 years ago, Ug99 – a deadly stem rust-causing fungus blighting African wheat — has since snowballed through Kenya, Ethiopia, Sudan and now Yemen. "I look at Yemen as the gateway into West Asia and Asia," says David Hodson of the Food and Agriculture Organisation. Indeed, fears are rife that Ug99 is headed for Punjab, south Asia's most important breadbasket that feeds hundreds of millions.

Researchers are trying to develop wheat strains that contain insurmountable genetic barriers for the fungus, but it is mutating, allowing a way to overcome the barriers put up by resistant genes in today's crops. Four variants of Ug99 are able to "knock out" such resistance genes.

In Njoro, Kenya, wheat breeders are working on promising varieties in the hope that one of these can outwit Ug99. And a two-year project to sequence the fungus genome hopes to identify the specific wheat-destroying genes so that new wheat breeds can be screened for Ug99 resistance. More farfetched dreams include the insertion of genes that can scramble Ug99 spores' "topographical sense" so that they cannot burrow into wheat.

Staying with Njoro, in a wheat field ringed by barbed wire, a dozen men wearing white polyethylene jumpsuits stand in a tight huddle, eyes fixed on the green-and-amber stalks that graze their knees. They chat in foreign tongues — Urdu, Farsi, Chinese — that are rarely heard amid the acacia trees and donkey carts of Kenya's Rift Valley. The men's *hazmat*-style safety gear suggests they might be hunting down one of the infamous viruses that flourish in this part of the world — Ebola, perhaps, or Marburg. Then the leader of the huddle, Harbans Bariana, a rotund Australian in an undersize safari hat, begins reading aloud from his clipboard. "Wylah?" he asks.

His colleagues bend down to examine some flaccid plants flecked with red splotches. A lanky Pakistani with a salt-and-pepper beard rakes a finger along one of the mottled stalks and an iodine-like residue rubs off on his skin. "40 S," he calls out.

The men move three steps right to a slightly more robust clump of wheat. The Australian asks: "Yandanooka?"

"25 MR?" comes the tentative reply from a mustachioed Nepali in a green baseball cap. They slide over to inspect another stalk, and then another.

These specialists have come to Njoro to study the Ug99 scourge that is destroying acres of Kenyan fields.

This distinct new race of *P. graminis*, dubbed Ug99 after its country of origin (Uganda) and the year of christening (1999), is storming east, working its way through Africa and West East and threatening India and China. More than a billion lives are at stake. "It's an absolute game-changer," says Brian Steffenson, a cereal-disease expert at the University of Minnesota who travels to Njoro regularly to observe the enemy in the wild.

— SciDev.Net