The index declined 6.2 percent, from 1,256.16 to 1,205.79, in a 20-minute span—an $862 billion paper loss—before recovering to finish down 3.2 percent.

Still, the brief crash threw up a flare that illuminated a financial topography that was unfamiliar even to the most experienced investors. A Bloomberg Businessweek investigation into these borrowing mismatches shows the extent to which the market is now dominated by quick-traders who have no intrinsic interest in the fate of companies or industries. Instead, these former mathematicians and computer scientists see securities as a cascade of abstract data. They direct their mainframes to sift the information flows for minute discrepancies, such as when futures contracts fall out of sync with related underlying stocks. High-frequency traders (HFTs), as they’re known, set an astonishing pace. On May 6, in billion shares were bought and sold; as recently as 1999, a billion shares constituted a very busy day.

The HFT wizards argue that all that extra buying and selling provide the liquidity that makes the market more efficient. As long as the machines are humming, electronic bids and offers abound. On May 6, however, we saw what happens when digital networks follow conflicting protocols and some of the mighty computers temporarily power down. Liquidity evaporates. Panic combined with automation leads to much faster panic.

The decline began midmorning as skirmishes intensified over the Greek economic debate spreading elsewhere in Europe. A closely watched gauge of volatility calculated by the Chicago Board of Exchange hit a high point for the year at 2:08 p.m. The volatility index, or VIX, is derived from options on the S&P 500, and it measures investor perceptions of market risk. When the VIX surged again, in its biggest gap in three years, some high-frequency programs may have automatically slowed their normal pace to limit losses, according to a May 6 research note by Nomura Securities.

Set orders piled up faster than buys, an imbalance that worsened over the next hour. During the period of heavy selling, starting around 2:20 p.m., the NYSE paused electronic trading in certain stocks and switched to computerized auctions conducted by human traders. This caused electronic sell orders to be rerouted to other trading venues, where there were few, if any, buy orders to absorb them. As Mary L. Schapiro, chairman of the Securities & Exchange Commission, put it in congressional testimony five days later, some high-frequency firms "withdrew their liquidity after prices declined rapidly.”

During the next few hours of confusion, exchanges began canceling trades in hundreds of stocks. NYSE Arca, an electronic platform operated by the Big Board, erased transactions in 295 companies. A surge in trades rejected by exchanges constitutes another trigger that automatically causes some high-frequency firms to slow down, says Ethan Kahn, a principal at Wolverine Trading, an electronic market-making outfit in Chicago: "You disable. You shut down." Wolverine pared back activity in equity futures because of concerns about the accuracy of data it was receiving, he adds.

In Washington, the SEC began reviewing up to 10 terabytes of market data to figure out what happened. Twelve days later, on May 18, the agency conceded that it still couldn’t offer a firm answer. That uncertainty in itself suggests the disquieting complexity the stock market now presents.

The SEC and the Commodity Futures Trading Commission issued a preliminary report in which they outlined six hypotheses that could explain the scare. "We continue to believe that the market disruption of May 6 was exacerbated by disparate trading rules and conventions across the exchanges," Schapiro said upon the report’s release. As one response, the SEC proposed that exchanges halt trading in individual stocks that swing more than 10 percent during a five-minute period. The new “circuit breaker” rules are subject to commission approval after 10 days of public comment.

While temporarily slowing trading during periods of investor high anxiety makes sense to regulators, at least some high-frequency traders disagree. “I don’t think that’s the right solution,” Wolverine’s Kahn told Bloomberg News after the S&P 500 recovered. “It could cause a lot of complications. On a busy day where the market is making major moves, we would have a handful of [stock] names where it’s circuit breaker-on/circuit breaker-off all day.” As this debate unfolds, one danger is that regulators, politicians, and industry executives—already distracted by how to reform Wall Street in the wake of the broader credit crisis of 2008—will shrug off May 6 as a weird blip requiring no fundamental rethinking of how man, machine, and market...
The Market Diaspora
Today's decentralized, virtual trading floors

Ever since the "curbside brokers" set up shop outside the New York Stock Exchange in the early 1800s, venues for trading shares in the U.S. have proliferated. Computerization in the 1970s and 1980s facilitated the dispersion of the business. In the late 1990s, the Securities & Exchange Commission adopted rules that spurred competition in Nasdaq stocks. That fragmented the industry even further. Now the U.S. stock market is actually a network of 50 different venues connected by an electronic system of published quotes and sales prices. In addition to the NYSE and Nasdaq, trading occurs on electronic platforms such as Direct Edge Holdings in Jersey City and on dozens of so-called "dark pools" such as Fidelity's Crossstream in Boston.

NYSE
Financial District
New York

Nasdaq
Micron Market

Direct Edge Holdings
Electronic-market center
Jersey City, NJ

Equities
Exchange data center
Sonoma, CA

Fidelity Crossstream
Small Broker
Chicago

Philadelphian Stock Exchange
Midtights

Invalidated

A入市

Hats Exchange
Kamakura City

Bats Exchange
Kamakura City

Manhattan Technologies
Bonds fund & BPT operation
East Senate, NY

Interactive
Absence so far from the public discussion is any talk about whether the next quick-cash crash might coincide with an outside event that shakers nearly every sector of the economy.

At the same time, the transformation has created new risks, some of which were already apparent in May. "What happened that day is completely unacceptable," says Rich and Gorelick, RIM's chief executive officer. Gorelick, who for months had run the Internet company's e-commerce, turned to May 6. "I got a lot of birthday calls," he says, "followed by, "What the hell happened?!"

Manuel A. Henriquez is no Lustiger. He has invested in technology companies for 23 years and runs Hercules Technology Growth Capital, a publicly traded venture firm in Palo Alto, Calif. On May 6 he gaped as Hercules shares fell from $9.50 to $5.22 in less than 30 minutes. The 46-year-old father of two, aged 50, who loaned his own money into the firm, was devastated. For a while that afternoon, he thought he had lost half of it. "I literally called my wife and said, 'Give the kids tennis rackets; they're going to have to get scholarships.'"

Hercules shares closed on May 6 at $9.56 after trading at twice their normal volume. If the Henriquez girls take up tennis, it will be for the love of sport. Still, their father remains shaken. "It's like invading 2001: A Space Odyssey," he says. "You can't have Hal the Computer make all the decisions for you. We need to synthesize the human element of logic and say, 'Wait a minute, I've got an ounce of that in this size. This seems to be an anomaly.'" When Henriquez started investing in the mid-1980s as a college student in Boston, he set aside $30,000 to buy shares. In that era, broker Richard Rosenblatt and his breed still had tremendous influence over the running of the Big Board, and, by extension, over the entire market in stocks. "I was much younger and pretty quick," Rosenblatt says. "I was the high-frequency trader at the time.

Rosenblatt Securities, launched in 1979, executes buy and sell orders for mutual funds and other money managers. When carrying out trades back then, Rosenblatt could see everyone he was dealing with, Specialists posted on the floor "made markets" in stocks they were assigned. They had the responsibility of buying even when a company's shares were falling. Big investors relied on their brokers to buy low and sell high. Unscrupulous traders could--and sometimes did--put their own interests ahead of those of their clients. Aside from exchange rules and the remote danger of prosecution, the trust among brokers and money managers was stronger.

Four years before Rosenblatt started his company, though, Congress had signaled that the era of traditional transactions was about to end. In 2001, the SEC voted to require Nasdaq to break up its network of some 2,000 independent dealers. That last 70{33} of a decade, the SEC's rule-making was focused on breaking down the barriers between the Big Board and its competitors. That is no longer the case. The SEC has approved a new set of guidelines for market-makers, allowing them to trade anywhere in the U.S. and compete with one another.

The agency's two primary purposes are improving the distribution process for electronic trading and increasing investor protection.

1974
Securities & Exchange Commission
Commission
Gordon's resignation in 1974 led to the decentralization of the country's market. The agency's powers were increased, but it remains fragmented.

1976
Fragmentation fears surface
Gordon's resignation in 1974 led to the decentralization of the country's market. The agency's powers were increased, but it remains fragmented.

1984
Fixing commissions abolished
The SEC banned minimum commissions on trading, after which many large institutional investors agreed to pay higher fees.

1982
Fixed commissions abolished
The SEC banned minimum commissions on trading, after which many large institutional investors agreed to pay higher fees.

1992
NASDAQ has its first 100-million-share day
Hercules Technology Growth Capital, a publicly traded venture firm in Palo Alto, Calif, gaped as Hercules shares fell from $9.50 to $5.22 in less than 30 minutes.

1993
NASDAQ market system established
The SEC's new market system was designed to provide nearly instantaneous information on Nasdaq transactions.

1994
Small order execution system established
The SEC's new market system was designed to provide nearly instantaneous information on Nasdaq transactions.

1996
Spread of proprietary trading and portfolio insurance
Program traders use software to buy or sell portfolios of securities in a single order while making elections for the best market price. This system is used as a risk management tool.
order, while simultaneously making offsetting bets on related futures contracts. Designed to hedge risks, program trading at times contributed to greater volatility. On Oct. 19, 1987, it helped accelerate the Black Monday market crash.

Historically, the NYSE and Nasdaq were nonprofits seen as utilities that served the public interest in matching investor resources with corporate enterprises. They evolved into for-profit corporations fighting for survival. Newer profit-making exchanges started explicitly to benefit the firms that ran and patronized them. “They’re more competitive, more self-serving, and they’ve moved more away from the utility concept,” says Rosenblatt. “Maybe it’s gone too far.”

SEC rule changes adopted in 1998, 2005, and 2007 aimed at ever-lower transaction costs by encouraging formation of electronic communication networks, or ECNs, that challenged the NYSE and Nasdaq for market share. Robert O’Hara, who oversaw the modernization process for 15 years as deputy director of the SEC’s Trading & Markets Dir., says the march of technology was irresistible. “Electronic trading allowed new automated markets to spring up and compete head-on with established exchanges and market makers,” he says.

David Leitweber, a finance professor at the University of California at Berkeley, helped create one of the first algorithmic trading strategies in 1989. Originally called Market Mind, it allowed computers to execute securities orders entirely on their own. Leitweber had studied math and physics as an undergraduate at the Massachusetts Institute of Technology. His preparation for the Market Mind breakthrough also included research he had done at the government-funded RAND Corp. think tank. There, he helped improve communication systems for real-time data analysis for the space shuttle. In the late 1990s he worked as a partner at First Quantum, a Pennsylvania-based investment firm. “I was managing equities all over the world at that time,” he says, and pretty soon there were just no [trading] floors to visit. You switched to trading electronically.”

Digital networks such as Island ECN and Archegos unseated the human trading floors by offering rebates on trading and faster execution. These innovative virtual trading sites lured the cadres of specialists and market makers obliged to maintain orderly trading. In their place were “liquidity providers” — brokers willing to post electronic bid and ask quotes, but free of institutional duties. Seemingly minor advances had profound consequences. The switch in 2006 to decimal share pricing, from stonerooms of a dollar, gave investors greater flexibility. Any firm willing to sell for a penny less than the best available price could step in and make the trade. A traditional Nasdaq market maker that had bought at $10 and sold at $0.0025 found itself in a lower-margin business. This favored the new electronic communications networks and the ever-speedier high-volume traders seeking microscopically profitable executions of transactions.

Market making moved away from exchange floors to computers. On its Web site, Wolverine at Chicago says its servers receive direct data feeds from more than 15 exchanges and execute more than 1.5 million orders a day. The culture of the industry changed, too. Membership on a college sports team no longer constitutes a ticket to an entry-level job. In the past, Wall Street traders were “taller, bigger, more aggressive,” says Kahn, who oversees market making at Wolverine. Today’s HFT firms, by contrast, look for “more of a quant-computer-type person,” says Kahn, who has a finance degree from the Wharton School.

The firms use a range of strategies. One is simultaneously posting bids and offers for ever-changing amounts of a single stock. Prices tend to vary by minuscule amounts on different electronic exchanges, so a stock can be bought at a lower price on one, then sold instantly at a higher price on another. The profit could be as little as a hundredth of a cent per share, which, multiplied by millions of shares a day, adds up to real money.

One thing that apparently happened on May 6 is that when HFT firms reacted to the market’s sudden moves by slowing their computers or switching them off, buy orders that had been placed only seconds earlier disappeared, causing huge price swings. HFT behavior, to be sure, wasn’t the only factor that turned a down day in the markets into an abrupt collapse.

One man is a rule that made exchange regulations. A golfer, he played the SEC, expected to consider requiring high-frequency traders to continue to make markets, even during a major sell-off.

Some would resist such a mandate. “No one should be forced to provide liquidity when CNBC is showing riots in Greece in the morning and there are worries the bailouts of Greece and Portugal will fall apart and they’ll default on their debt,” says Pipeline’s Fred Foger.

On another front, some lawmakers have proposed erecting a tiny tax on each equity trade. Such a levy would likely discourage some high-frequency trading, slow the market’s pace overall, and raise billions in revenue for the federal government. Some of the tax proceeds could be used to bolster SEC monitoring.

After the frenzy of May 6, Clarence Woods of Baltimore says he ended up more or less where he started. He’s moving ahead with plans for his new hedge fund and counts on the SEC to reassure the market: “We’ll sit back, see what works and what doesn’t,” Manuel Henriquez, the Palo Alto venture capitalist, acknowledges “a visceral reaction to pull all the computers out.” He doesn’t think that’s feasible, though. “We need to continue to embrace technology, but understand that technology can bite both ways.”

Matt Andresen helped launch Island ECN in 1996 and later oversaw market making at Citadel Investment Group, which he left in March 2009. “The impact of the high-frequency tool has been, I believe, very democratizing,” he says. Brokers selling individual investors can execute orders more quickly and less expensively— at least on most days. Then there was May 6. “Whatever the cause of it,” Andresen says, “the failure mode was unacceptable.”

—With Jeff Kahn, Whitney Rider, and Peter Cay