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(Smith/Grossman)
January 21, 1992
Draft Two
RELIGION

PRESIDENTIAL REMARKS: RELIGIOUS BROADCASTERS
SHERATON WASHINGTON HOTEL
MONDAY, JANUARY 27, 1992
10:00 A.M.

President Rose and Director Cook -- and let me salute your leadership of the NRB. Ladies and gentlemen. Fellow communicators. // This marks the fifth time I have had the honor of addressing the annual convention of the National Religious Broadcasters. ((It's always a pleasure driving over here from the White House. I think if Moses were around today, he'd be called upon to part the traffic.)) //

((First, I'm glad to see my friend Jerry Fallwell. I invited Jerry to go jogging with me this morning, but he had his own exercise plans. / He walked across the Potomac.)) //

((Then, there's my other friend, Pat Robertson. Pat was telling me you have the lowest catering bill of any convention that comes to this hotel. // It's amazing how you can feed this entire multitude on seven loaves and fishes.)) //

A year ago we met in the first week of a crusade to protect what is right, and true. I came before you to talk of what was not a Christian or Jewish war -- not a Moslem war. It was a <u>just</u> war. // In the Persian Gulf we fought for good versus evil / right versus wrong / dignity against oppression. America <u>stood fast</u> -- so that liberty could <u>stand tall</u>. //

Today, I want to thank you for helping America, as Christ ordained, "be a light unto the world." Your support honored the finest sailors / soldiers / Marines / Air Force / and Coast Guardsmen any Nation has ever known. // What they did in war, let us now do in peace. // Just as our forces fought to defend all that is best in America, we need you to help instill the traditional values that make life and liberty worth defending. //

Allison Gallup, Managing Director of Princeton Religion Research Center. (609) 924-9600

Let me begin with some good news for modern man. According to Gallup surveys, no society is more religious than the United States of America. // Seven in ten Americans believe in life after death -- eight in ten that God works miracles. Nine in ten Americans pray. And more than nine in ten believe in God. // To which I say: Thank God. //

Is there a Gallup Company? YES! George Gallup

Now, I know this is an election year. ((I don't know about Damascus -- but this Primary Season, we're hearing plenty of conversions on the road to New Hampshire.)) // We hear candidates promising this, and that -- espousing policies suddenly in fashion. // Today, I want to speak of values which sustain America -- values that are always in fashion. //

The first value is not simply American -- but universal. I refer to the sanctity of life. You know my position -- but I'll restate it now. We need policies that encourage adoption, not abortion. //

Next comes a value which gives each life meaning: The self-reliance central to the dignity of work. // Go to the barrios of San Antonio, or the suburbs of St. Paul. There you will find people who ask only what our forefathers had: The same opportunity which helped us brave independence / push back the wilderness / win two World Wars / and create the highest standard of living in the history of man. //

The Bible reminds us: "By thy sweat shall ye know them." What we must do is give working Americans the level playing field to keep us rich in goods, and spirit. //

David Garrett NASA News Chief 453-8400

Tomorrow, my State of the Union Address will detail how we can nurture the creativity as old as 1776 -- harness it to the needs of a new American Century. // Remember: To this day, the only footprints on the moon are American footprints. / The only flag on the moon is the stars and stripes. // The knowledge that put it there is stamped: "Made in USA." // The world looks to us to lead -- and lead we will. // Tune in tomorrow, and see if you don't agree: I will announce a program to help Americans outwork / outproduce / and outcompete any Nation in the world. //

The next value I speak of must be forever cast in stone. // I speak of decency -- the moral courage to say what is right, and condemn what's wrong. // We need a nation closer to The Waltons than the Bundys or the Simpsons -- an America which rejects the rising tide of incivility and intolerance. //

We see this tide in the naked epithet -- and in the code words -- that play to our worst prejudices. / We see it when groups like Public Enemy soil the memory of Martin Luther King, Jr. with vengeance and violence. // There is no place in America for such apostles of hate. // If you agree with me, write -- call -- picket -- petition: Demand an end to the trash which poisons our kids's minds and debases their souls. //

This brings me to a <u>fourth</u> value crucial to America: Belief in <u>family</u> -- the foundation of our strength. ((I admit it: I've been lucky -- a wonderful wife and five great kids. // Having helped put them through college, I remember receiving letters from them, and there would always be a P.S. at the bottom. It was those three words that say so much about the bond between parents at home and kids at school. "Please send money.")) //

Phillippians reminds us, "Whatsoever things are pure . . . think on these things." To me, this is what family is: A pure and priceless bequest. // Too often today, the family is under siege. I say to you: Each one of us -- parents, preachers, politicians, and teachers -- must lift it from the valley of indifference to the high plateau of Canaan. //

That is why I demanded that the child-care bill I signed in 1990 allow <u>parents</u> -- not <u>bureaucrats</u> -- to decide how to care for their children. I refused to see the option of <u>religious-based child care restricted or eliminated</u>. // The family is also why our education program -- America 2000 -- insists that <u>choice</u> include both <u>private</u> and <u>public</u> schools. // Last week, I announced another policy to strengthen the family: Expanding the pre-school program to serve all those who are eligible -- the <u>largest funding increase</u> in the <u>history</u> of Project Head Start. // Finally, families will stay <u>together</u> only if drugs do not drive them <u>apart</u>. As Elijah drove the false prophet Baal [BALE] out of Israel, <u>we</u> must erase drugs from every corner of America. //

I will be honest: We have not erased them yet. But in the spirit of the occasion, let me add: Our progress has been miraculous. // Over the past four years, marijuana, crack, and cocaine use has declined. What's more, today kids aged 9 to 12 are the most anti-drug group in America. The highest at-risk is ages 13 to 17 -- but last year / for the first time / 13-year-olds mirrored the behavior of pre-teenagers. //

Drugs effect a multitude of issues. They contribute to AIDS and homelessness -- shattering families and futures / hopes and dreams. / That's why -- literally -- we should thank God for the drug use decline. The drop in use doesn't just prove we were right in our assault on substance use: It shows how we can achieve drugs' unconditional surrender. //

We will triumph through tough enforcement -- and through education: Increasing awareness of the damage drugs do. // Over the last four years, more kids talked about drugs with their parents and teachers. Another force has been America's print and electronic media -- the major source of drug information and the primary "influencer" on drug use, especially among the young. // Together, they have helped reawaken America's conscience -- which, in turn, inspires America's greatness. / Later today, I will unveil our fourth National Drug Control Strategy to build on these beginnings. It will say no to drugs. It will also say yes to life. //

To stop drug use will require caring, and community -- above all, abundant love. / Let me tell you a story. Once, a great First Lady -- Pat Nixon -- toured a medical center and stopped to embrace a little girl blinded by rubella. For a few minutes, she talked to the girl and held her close. Later, someone told her that the child was deaf as well as blind. // Pat answered that she had known that. // "But she knows what love is," Mrs. Nixon said. "She can feel love." //

See Speech Sept 18, 1991 Salt Lake City, UT.

America's love is conveyed in many ways. In what we oppose: Injustice and tyranny. In what we support: The inalienable rights that include the freedom to think, dream, worship, and, yes, vote as we please. // To preserve our liberty, America once deposed a king / fought a great Civil War / five times this Century sent Americans into major battle. Yet freedom is not ours alone -- so we have exported it as our ideal. Today, we must also export it economically, and, above all, spiritually. // If you doubt freedom's victory, look to the Persian Gulf. / Look to the former Soviet Union, where those once enslaved crowd churches and synagogues. / Look to Eastern Europe, where Christmas carols warm the bright winter chill. // It is written: "In the beginning was the Word." Here is the word for 1992: Today, the times are on the side of peace -- because the world, increasingly, is on the side of God. //

↑ Pat Nixon
Sept SLC, Utah
92MX17C
POTUS speech in Co or Utah
Hosp visit

This brings me to the ultimate value that sustains America, and the values I have already cited: A belief in prayer --and through prayer, in the One through whom all things are possible. // No country can claim a special place in God's heart. Yet we are better as a people because He has a special place in ours. //

I once asked one of my grandkids how he felt about prayer. He said: "Just try getting through a math test without it." // In Sunday school, children learn that God is everywhere -- but in public school they find that He's absent from class. It's time to end this mockery. // I continue to believe -- as do the overwhelming majority of Americans -- in the right to voluntary school prayer. / I call on the Congress to pass a Constitutional Amendment putting the Faith of our Fathers back in our schools. /

The values I have spoken of reminds us of the truth that comes on one's knees. // I believe with all my heart that one cannot be America's President without a belief in God and in prayer. I also believe America will be a better place if the Golden Rule becomes our daily guide. //

The poet Walt Whitman was once asked to name America's true grandeur. He replied, simply: "Its religion. Without that, America is not America." // Let that be our essence as a people -- and our message as a Nation. Thank you for this occasion. God bless this most wondrous land on earth -- the United States of America.

# # # #

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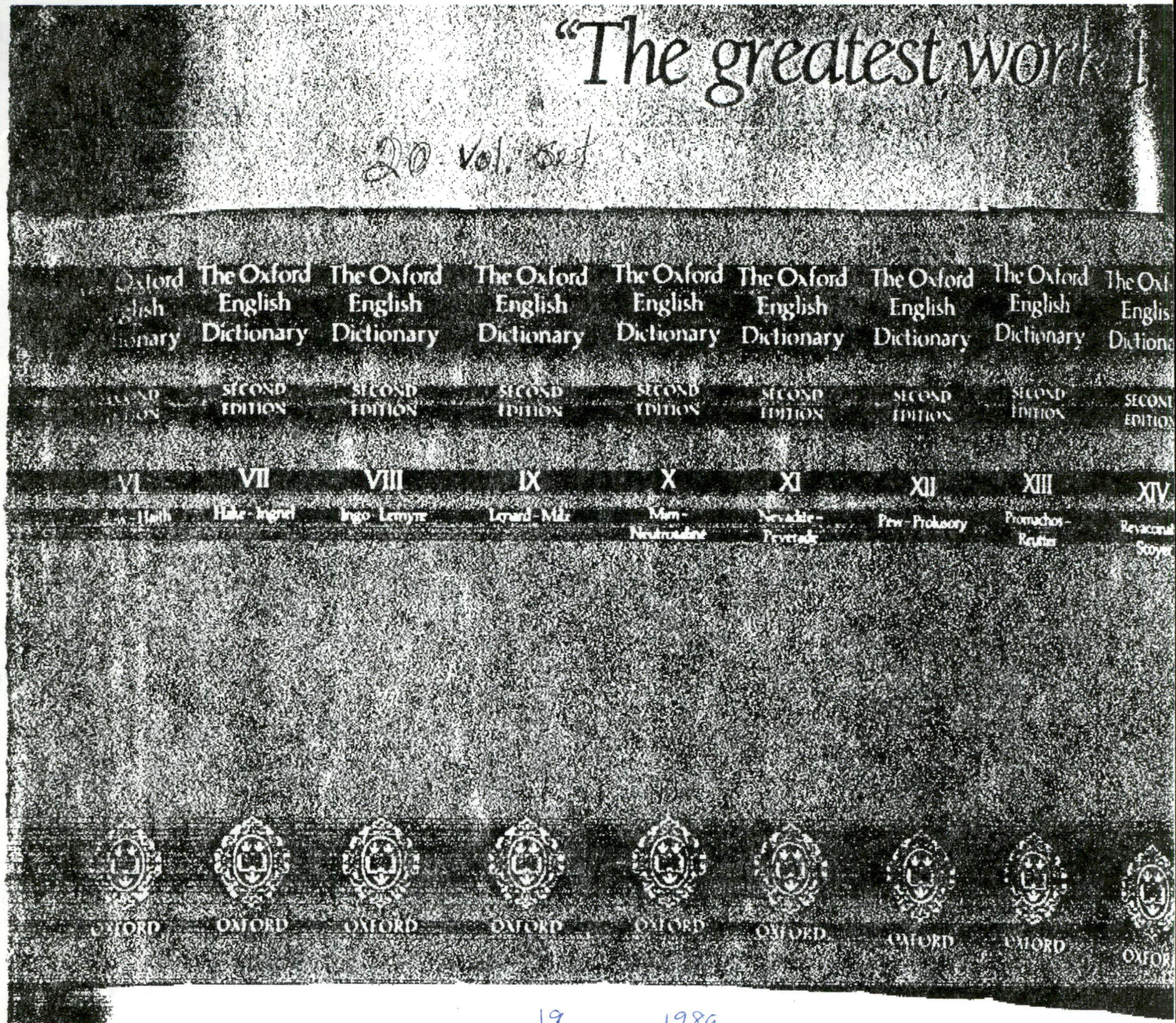

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1991 FALL
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The Compact OXFORD ENGLISH DICTIONARY

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No. 1347. Factory Sales of Electronic Components and Consumer Electronic Products: 1980 to 1989

[In millions of dollars]

PRODUCT	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
Electronic components	**25,571**	**28,784**	**29,561**	**33,856**	**43,306**	**39,459**	**38,829**	**45,335**	**50,735**	**54,626**
Solid state products	9,089	10,309	10,729	12,570	17,032	14,650	14,408	16,819	19,685	21,650
Parts	7,080	7,647	7,403	8,318	10,155	9,329	9,169	10,664	11,292	11,678
Electron tubes	1,744	1,959	1,885	2,049	2,137	2,055	2,125	2,176	2,263	2,578
Other components [1]	7,658	8,869	9,544	10,919	13,982	13,423	13,121	15,676	17,495	18,720
Consumer electronic products	**10,891**	**12,438**	**12,499**	**14,560**	**17,594**	**18,907**	**21,472**	**21,828**	**22,132**	**(NA)**
Color TV receivers	4,210	4,349	4,253	5,002	5,538	5,565	6,040	6,303	6,277	6,530
Car audio	1,368	2,000	2,100	1,900	2,500	2,761	3,135	3,523	3,937	4,125
Video cassette recorders	621	1,127	1,303	2,162	3,585	4,173	3,978	3,442	2,848	2,625
Camcorders	621	1,127	1,303	2,162	3,585	4,738	1,280	1,651	1,972	2,007
Separate audio components	1,424	1,363	1,181	1,268	913	1,132	1,358	1,715	1,854	1,871
Portable audio tape equipment	1,403	1,157	971	1,102	1,191	1,140	1,389	1,469	1,547	1,595
Audio systems [2]	809	720	573	630	976	1,372	1,370	1,048	1,225	1,217
Blank video cassettes	(NA)	(NA)	357	580	770	1,055	1,235	1,006	936	923
Projection TV	(NA)	287	236	268	385	488	529	527	529	478
Home radios	468	501	530	565	661	379	408	409	377	379
Blank audio cassettes	(NA)	227	202	234	256	263	292	364	354	367
Monochrome TV receivers	588	505	507	465	419	328	373	341	236	156
Video disc players	(NA)	55	54	81	45	23	26	30	40	59
Color cameras	(NA)	147	232	303	355	228	59	(NA)	(NA)	(NA)

NA Not available. [1] Includes sockets, delay lines, loudspeakers, magnetic components, transducers, printed circuit boards, microwave components, assemblies, and parts. [2] 1980 includes console phonographs.

Source: Electronic Industries Association, Washington, DC, *Electronic Market Data Book*, annual. (Copyright.)

No. 1348. Selected Electric Home Appliances and Consumer Electronic Products—Shipments and Retail Value: 1985 to 1989

[Compiled from report of associations and manufacturers. Retail value represents median price of product times the number of units shipped. Except as indicated, covers electric appliances only]

PRODUCT	MANUFACTURES SHIPMENTS (1,000 units)					RETAIL VALUE (mil. dol.)				
	1985	1986	1987	1988	1989	1985	1986	1987	1988	1989
Major appliances:										
Air conditioners	2,900	2,765	3,659	4,379	4,909	1,286	1,130	1,502	1,774	2,012
Refrigerators [1]	5,874	6,284	6,724	6,973	6,799	4,121	4,299	4,557	4,860	4,881
Microwave ovens	10,633	12,658	12,741	11,189	10,848	3,468	3,600	3,541	2,726	2,541
Ranges, electric	3,218	3,532	3,362	3,186	3,068	1,517	1,589	1,643	1,545	1,524
Freezers [2]	1,140	1,154	1,180	1,250	1,189	546	517	526	555	544
Ranges, gas	1,807	1,895	2,132	2,132	2,068	821	880	992	989	960
Dryers	3,701	4,114	4,421	4,363	4,404	1,326	1,451	1,544	1,536	1,422
Washers	4,925	5,430	5,610	5,708	5,765	2,231	2,379	2,470	2,514	2,341
Video:										
TV, color	16,894	18,855	18,473	19,173	20,955	7,250	7,632	8,221	8,434	8,749
Videocassette recorders	11,912	12,685	11,700	10,998	9,843	(NA)	5,067	4,553	4,348	3,767
Camcorders	(NA)	1,090	1,600	2,108	2,348	(NA)	1,213	1,674	2,082	2,170
Video cameras	402	181	110	90	81	266	118	77	62	51
Video cassette players	(NA)	150	182	213	234	(NA)	28	28	32	35
Audio/HiFi:										
Components [3]	8,800	10,914	12,085	12,858	14,050	1,653	2,041	2,232	2,571	3,060
Compact disc players	850	1,384	2,490	2,237	2,338	264	356	514	512	511
Tape decks	908	1,508	1,458	1,457	1,542	176	284	282	283	289
Portable tape equipment	27,626	30,635	30,753	29,556	31,085	1,333	1,449	1,442	1,372	1,452
Radios	27,528	29,896	30,678	27,252	28,371	808	845	818	761	815
Headphones	3,167	3,425	3,534	3,477	3,755	134	140	149	146	160
Cartridges	3,047	2,795	2,539	1,803	1,533	94	86	78	58	42
Mobile electronics:										
ID [4] cassette/radio combo	4,030	3,989	4,053	4,256	4,098	789	814	848	905	865
Radios only	867	757	687	664	551	81	65	59	58	49
Car speakers (in pairs)	15,162	15,010	16,241	17,540	18,294	979	942	993	1,070	1,104
Radar detectors	1,227	1,688	1,834	1,953	2,051	187	263	277	295	341
Cellular telephones	(NA)	265	331	700	1,081	(NA)	423	509	578	667
Auto security systems	(NA)	1,028	1,371	1,759	2,023	(NA)	257	308	358	360
Home office:										
Electronic typewriters	850	2,038	2,186	2,481	2,580	185	458	533	672	740
Personal computers	4,025	3,075	3,598	4,192	4,737	(NA)	2,983	3,313	3,810	4,694
Facsimile machines	(NA)	181	525	900	1,400	(NA)	584	1,335	1,335	1,540
Blank floppy disks	205,063	425,000	545,403	651,757	706,505	(NA)	680	764	878	883
Satellite earth stations	630	255	252	277	294	1,386	513	508	624	657
Telephone equipment:										
Corded telephones	22,403	23,768	21,900	20,805	20,493	983	1,006	840	808	798
Cordless telephones	4,076	4,279	5,450	8,000	9,200	380	410	455	680	796
Telephone answering equipment	3,306	4,856	7,332	10,100	12,160	371	535	654	873	986

NA Not available. [1] 6.5 cu. ft. and over. [2] 10 cu. ft. and over. [3] Includes others not shown separately. [4] ID=in dash.

Source: Dealerscope Merchandising, Philadelphia, PA, 68th Annual *Statistical and Marketing Report.*

No. 1078. On-Time Flight Arrivals and Departures at Major U.S. Airports: 1989 and 1990

[**In percent.** Quarterly, based on gate arrival and departure times for domestic scheduled operations of major U.S. airlines, per DOT reporting rule effective September 1987. All U.S. airlines with one percent or more of total U.S. domestic scheduled airline passenger revenues are required to report on-time data. A flight is considered on time if it operated less than 15 minutes after the scheduled time shown in the carrier's computerized reservation system. Cancelled and diverted flights are considered late. Excludes flight operations delayed/cancelled due to aircraft mechanical problems reported on FAA maintenance records (4-5% of the reporting airlines' scheduled operations). See source for data on individual airlines]

AIRPORT	ON-TIME ARRIVALS						ON-TIME DEPARTURES					
	1989				1990		1989				1990	
	1st qtr.	2d qtr.	3d qtr.	4th qtr.	1st qtr.	2d qtr.	1st qtr.	2d qtr.	3d qtr.	4th qtr.	1st qtr.	2d qtr.
Total, all airports	73.9	78.3	77.0	75.9	75.9	81.0	80.6	84.9	83.7	81.8	81.9	88.2
Total, 30 major airports	**72.8**	**77.4**	**75.7**	**74.9**	**74.8**	**80.0**	**79.0**	**83.4**	**81.5**	**80.1**	**80.2**	**87.0**
Atlanta, Hartsfield International	79.9	80.7	79.2	78.8	69.8	83.3	85.2	85.9	85.2	83.2	76.5	88.6
Baltimore/Washington International	72.4	71.4	69.6	71.9	77.5	83.4	74.6	74.3	73.6	76.1	82.9	89.2
Boston, Logan International	79.4	75.6	70.2	72.5	68.1	78.2	83.0	81.7	77.2	77.9	75.8	87.1
Charlotte, Douglas	67.5	70.4	66.0	71.4	78.7	87.9	68.0	69.8	65.9	71.5	80.2	90.6
Chicago, O'Hare	60.8	70.4	67.1	72.0	69.2	74.7	68.7	77.4	73.2	76.2	74.2	82.1
Dallas/Ft.Worth International	72.5	80.3	86.0	84.4	74.8	78.1	76.4	84.5	89.8	87.1	78.3	85.1
Denver, Stapleton International	69.0	79.3	81.2	77.8	72.1	76.8	76.1	85.8	84.5	83.0	77.5	85.0
Detroit, Metro Wayne	79.8	81.4	73.8	76.2	75.6	84.4	84.9	86.0	82.5	81.9	80.1	89.7
Dulles International	76.5	80.4	76.8	82.2	83.0	85.4	81.2	84.0	82.4	84.7	85.5	89.4
Houston Intercontinental	77.8	81.6	86.1	77.8	73.5	79.9	83.2	86.9	89.2	84.1	82.7	87.4
Kansas City International	73.6	79.4	76.3	75.3	76.6	79.8	82.4	87.2	85.6	82.1	83.6	88.5
Las Vegas, McCarran International	78.1	85.3	84.6	79.6	80.9	85.5	84.5	91.4	90.1	85.6	85.6	91.3
Los Angeles International	73.1	77.7	76.1	75.1	78.4	78.1	82.3	85.6	80.9	80.5	84.1	88.0
Memphis International	80.6	84.6	79.8	80.4	84.8	89.1	85.9	88.7	86.8	86.0	86.1	91.0
Miami International	75.3	73.0	72.2	73.9	76.8	84.3	80.7	81.2	80.8	82.6	82.9	88.9
Minneapolis/St. Paul International	77.9	83.8	79.5	77.4	81.4	79.7	81.6	88.0	85.6	82.4	83.1	85.4
Newark International	73.1	71.3	67.5	71.6	71.8	74.3	78.1	79.3	76.8	78.5	80.0	85.0
New York, Kennedy International	72.1	71.3	68.9	72.1	73.3	75.3	76.4	74.2	70.6	73.8	79.3	81.2
New York, LaGuardia	73.5	69.3	64.6	67.0	68.4	76.7	82.3	80.9	77.2	75.5	77.8	85.3
Orlando International	75.0	76.8	74.4	72.9	73.2	81.3	83.2	85.6	85.3	84.6	83.5	90.7
Philadelphia International	72.9	76.3	70.5	67.6	70.0	75.9	80.1	82.6	77.1	71.4	75.7	84.3
Phoenix, Sky Harbor International	74.2	84.4	84.2	72.5	77.7	84.5	77.6	87.3	88.0	78.0	79.9	88.4
Pittsburgh, Greater International	76.8	78.2	72.4	67.9	76.7	83.0	79.2	80.2	70.8	66.4	76.7	85.9
St. Louis, Lambert	70.0	81.5	82.8	81.2	80.7	81.3	74.8	85.9	86.7	82.4	83.5	85.6
Salt Lake City International	72.6	83.9	84.8	80.5	80.4	84.5	79.6	90.7	89.6	85.4	84.7	91.6
San Diego International, Lindbergh	71.9	79.7	77.2	74.4	75.7	79.0	80.1	85.4	81.2	80.2	82.9	87.5
San Francisco International	61.6	70.3	66.2	65.4	73.8	69.6	75.9	82.3	77.8	78.0	82.5	84.0
Seattle-Tacoma International	70.4	77.2	75.4	67.6	69.9	74.3	81.1	87.4	82.0	79.6	82.0	86.9
Tampa International	75.0	77.0	74.6	72.7	74.6	82.3	83.3	84.4	84.8	83.7	84.4	91.0
Washington National	76.6	75.3	74.6	75.4	79.4	83.5	85.8	84.2	83.6	80.2	84.2	89.1

Source: U.S. Department of Transportation, Office of Consumer Affairs, *Air Travel Consumer Report*, monthly.

No. 1079. Consumer Complaints Against U.S. Airlines: 1987 to 1990

[Calendar year data, except as indicated. See source for data on individual airlines]

COMPLAINT CATEGORY	COMPLAINTS				PERCENT DISTRIBUTION				RANK			
	1987	1988	1989	1990, Jan.-June	1987	1988	1989	1990, Jan.-June	1987	1988	1989	1990, Jan.-June
Total	**40,985**	**21,493**	**10,553**	**4,353**	**100.0**	**100.0**	**100.0**	**100.0**	**(X)**	**(X)**	**(X)**	**(X)**
Flight problems [1]	18,019	8,831	4,111	1,787	44.0	41.1	39.0	41.1	1	1	1	1
Baggage	7,438	3,938	1,702	767	18.1	18.3	16.1	17.6	2	2	2	2
Customer service [2]	3,888	2,120	1,002	376	9.5	9.9	9.5	8.6	3	3	4	4
Refunds	3,313	1,667	1,023	445	8.1	7.8	9.7	10.2	4	4	3	3
Oversales [3]	2,122	1,353	607	235	5.2	6.3	5.8	5.4	6	6	6	6
Reservations/ticketing/boarding [4]	2,458	1,445	821	297	6.0	6.7	7.8	6.8	5	5	5	5
Smoking	888	546	232	47	2.2	2.5	2.2	1.1	8	7	8	9
Fares [5]	937	455	341	157	2.3	2.1	3.2	3.6	7	8	7	7
Advertising	344	141	89	50	0.8	0.7	0.8	1.1	9	9	9	8
Credit	101	35	19	2	0.2	0.2	0.2	-	10	11	11	11
Tours	90	37	22	9	0.2	0.2	0.2	0.2	11	10	10	10
Other	1,387	925	584	181	3.4	4.3	5.5	4.2	(X)	(X)	(X)	(X)

- Represents zero. X Not applicable. [1] Cancellations, delays etc. from schedule. [2] Unhelpful employees, inadequate meals or cabin service, treatment of delayed passengers. [3] All bumping problems, whether or not airline complied with DOT regulations. [4] Errors in reservations and ticketing; problems in making reservations and obtaining tickets. [5] Incorrect or incomplete information about fares, discount fare conditions and availability, etc.

Source: U.S. Dept. of Transportation, Office of Consumer Affairs, *Air Travel Consumer Report*, monthly.

NOVEMBER 1991
AIR TRAVEL CONSUMER REPORT

TABLE 1A. OVERALL PERCENTAGE OF REPORTED FLIGHT OPERATIONS ARRIVING ON TIME AND CARRIER RANK, BY MONTH, QUARTER, AND DATA BASE TO DATE

CARRIER	4TH QUARTER OCT-DEC 90		1ST QUARTER JAN-MAR 91		2ND QUARTER APR-JUN 91		3RD QUARTER JUL-SEP 91		SEP 91		OCT 91		NOV 91		12 MONTHS DEC90-NOV91		DATA BASE TO DATE SEP 87-NOV 91	
	%	RANK	%	RANK	%	RANK	%	RANK	%	RANK	%	RANK	%	RANK	%	RANK	%	RANK
ALASKA	75.2	(10)	80.1	(5)	89.5	(1)	87.8	(4)	91.1	(2)	86.9	(5)	78.4	(10)	83.8	(3)	80.4	(5)
AMERICA WEST	79.2	(5)	76.8	(6)	87.7	(4)	87.1	(5)	90.8	(4)	88.0	(3)	90.0	(1)	83.5	(4)	84.4	(1)
AMERICAN	77.0	(9)	82.1	(4)	87.2	(5)	84.9	(8)	85.8	(11)	79.7	(12)	82.0	(6)	82.5	(8)	81.4	(4)
CONTINENTAL	78.4	(7)	78.8	(8)	80.9	(11)	83.8	(8)	87.2	(10)	83.1	(7)	81.0	(8)	80.4	(9)	78.7	(10)
DELTA	77.2	(8)	77.2	(7)	81.7	(10)	83.0	(11)	85.7	(12)	82.6	(9)	81.8	(7)	79.8	(10)	79.0	(8)
EASTERN *	81.0	(4)	----	--	----	--	----	--	----	--	----	--	----	--	71.0	(13)	79.5	(7)
MIDWAY **	----	--	72.5	(8)	88.3	(2)	88.1	(3)	90.4	(5)	87.0	(4)*	----	--	82.8	(7)	82 5	(3)
NORTHWEST	82.5	(3)	82.9	(2)	87.8	(3)	90.0	(2)	91.1	(3)	88.3	(2)	79.9	(9)	85.5	(1)	80.2	(6)
PAN AMERICAN	85.6	(1)	82.6	(3)	85.1	(7)	82.2	(12)	88.3	(7)	84.4	(6)	83.1	(4)	83.2	(5)	78.8	(9)
SOUTHWEST	74.9	(11)	72.1	(11)	84.1	(6)	91.2	(1)	93.5	(1)	89.9	(1)	89.6	(2)	82.9	(6)	82.9	(2)
TWA	73.7	(12)	70.1	(12)	82.1	(9)	83.3	(9)	88.4	(6)	80.8	(11)	83.0	(5)	77.6	(12)	77.2	(12)
UNITED	78.7	(6)	72.3	(10)	77.9	(12)	83.1	(10)	87.2	(9)	81.1	(10)	78.1	(11)	77.6	(11)	75.9	(13)
USAIR	83.3	(2)	83.5	(1)	86.0	(8)	84.3	(7)	87.3	(8)	83.0	(8)	85.5	(3)	84.0	(2)	78.5	(11)
TOTAL	79.1		78.5		84.1		85.2		87.9		83.4		82.7		81.5		79.2	

* EASTERN AIR LINES CEASED OPERATIONS ON JANUARY 19, 1991; THE ON-TIME PERFORMANCE STATISTICS INCLUDE EASTERN'S DATA THROUGH DECEMBER 31, 1990.

** MIDWAY AIRLINES BEGAN REPORTING ITS FLIGHT DATA ON JANUARY 1, 1991; CARRIER CEASED OPERATIONS ON NOVEMBER 14, 1991.

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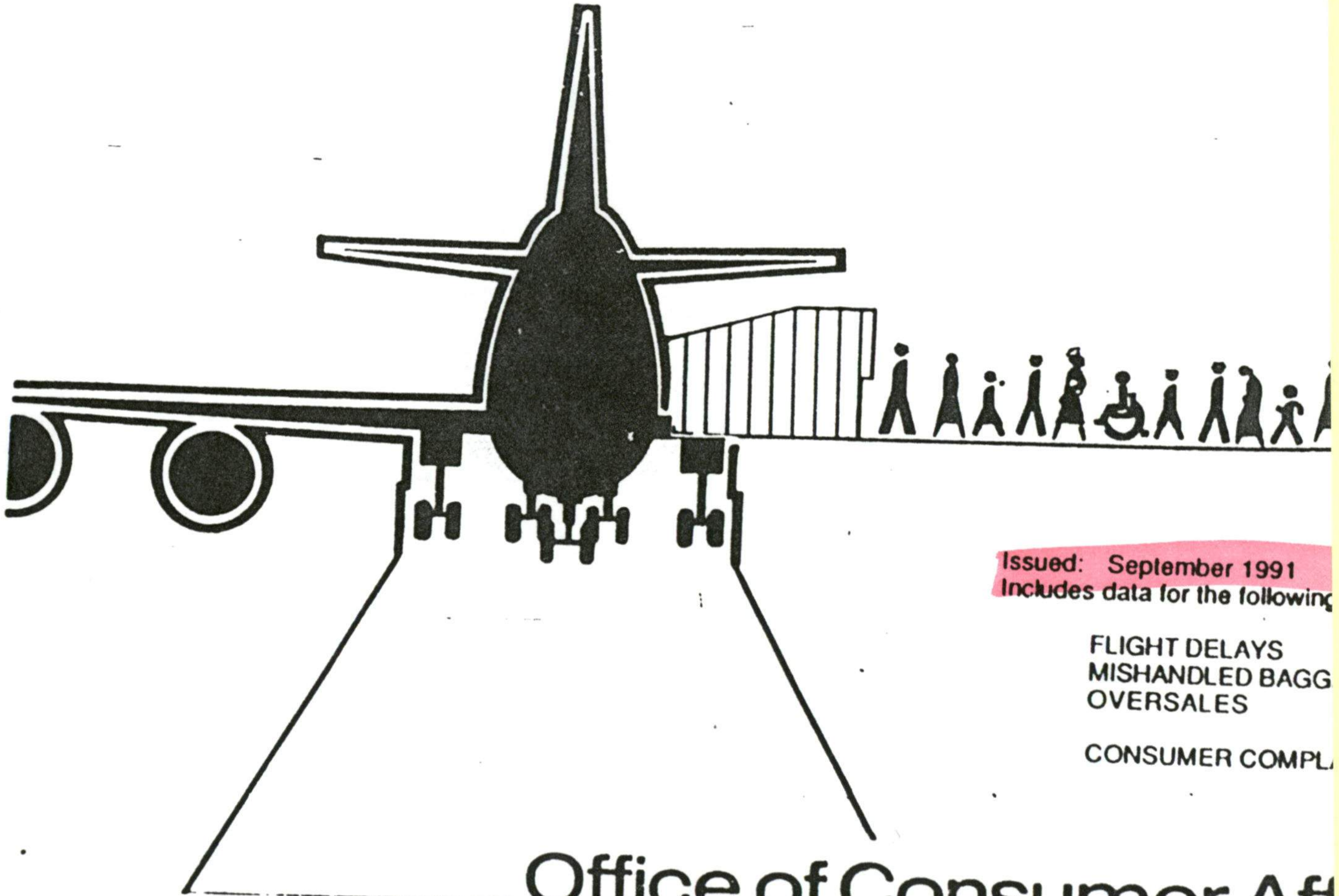
Co.	Co. DOT
Dept.	Phone # 202-366-5946
Fax # 202-456-6218	Fax # 202-366-7907

US Department
of Transportation

Air Travel Consumer Report



Issued: September 1991
Includes data for the followinc

FLIGHT DELAYS
MISHANDLED BAGG
OVERSALES

CONSUMER COMPL/

Need more recent issue including year-long wrap-up

Office of Consumer Affairs

INTRODUCTION

The Air Travel Consumer Report is a monthly product of the Department of Transportation's Office of Consumer Affairs. The report is designed to assist consumers with information on the quality of services provided by the airlines.

The report is divided into four sections. These sections deal with flight delays, mishandled baggage, oversales and consumer complaints. Each section of the report is preceded by a brief explanation of how to read and understand the information provided.

The report normally is released by the end of the first week of each month. If you are interested in obtaining a single copy, write to the Office of Consumer Affairs, U.S. Department of Transportation, 400 7th Street, S.W., Room 10405, Washington, DC 20590.

FLIGHT DELAYS

This section provides information about airline on-time performance and flight delays. It is based on data filed by airlines each month with the Department of Transportation as required by 14 CFR Part 234 of DOT's regulations. It covers nonstop scheduled-service flights between points within the United States (including territories) by the 12 largest U.S. air carriers, i.e., those with at least one percent of total domestic scheduled-service passenger revenues. These airlines account for more than 90 percent of domestic operating revenues.

The rule requires carriers to report on operations to and from the 31 largest U.S. airports (those with at least one percent of the nation's total domestic scheduled-service passenger enplanements). However, all 12 airlines have voluntarily provided data for their entire domestic systems, and that information is included in this report.

A flight is counted as "on time" if it operated less than 15 minutes after the scheduled time shown in the carriers' Computerized Reservations Systems. All tables in this report except Table 4 are based on gate arrival times; Table 4 is based on gate departure times. Cancelled and diverted operations are counted as late. Because of our concern that the rule not penalize carriers for conscientious safety practices, a delay is not reported to DOT if it results from a mechanical problem that is required to be reported to the Federal Aviation Administration.

As indicated above, a carrier may voluntarily file data for its entire domestic system. Tables 2, 3, and 4 are limited to the 31 required or "reportable" airports; Tables 5 and 6 contain data on flights to/from all airports that were reported. Table 1 has one column for the 31 "reportable" airports and another for all of the airports reported; see footnote C for additional explanation.

Tables 1 through 4 display percentages of flight operations that were on time, while Tables 5 and 6 show service that was late. Tables 1, 1A, and 2 present data by carrier; airlines are ranked by performance in Table 1 and are listed in alphabetical order by carrier code in Table 2 (see Appendix for codes). Beginning with the February 1988 report, Table 1A shows carrier rankings by month and time-series data on the percentage of flight operations that arrived on time.

Tables 3 and 4 provide information by airport and time of day. Table 5 is a list of the most frequently delayed flights, showing the percentage of each flight's operations that were late that month and the average and median number of minutes the flight was late. The flights with the highest percentage of large operations are listed first in Table 5; where percentages are identical, flights are listed alphabetically by carrier code. Table 6, like Tables 1, 1A, and 2 presents data by carrier, but lists the carriers in rank order from worst to best based on the number of flights which were late 70% of the time or more.

Tables 3, 4, and 5 contain information on the time of day that a flight operated. All times are local. A 10:50 a.m. departure from Atlanta is 10:50 a.m. Atlanta time; if that flight arrived in Dallas at 11:45 a.m., that is 11:45 a.m. Dallas time. If a flight's scheduled operating time changed during the month, Table 5 shows the time that was in effect for the last flight operation performed that month.

This report provides summary information; except for the few flights listed in Table 5, it does not show the on-time record of individual flights. A printout showing the performance of each specific flight reported to DOT is available for inspection in the Reports Reference Room (room 4201) of the Office of Airline Statistics at DOT's headquarters in Washington, D.C. Copies of this printout and computer tapes containing data for all reported flight operations are available for purchase from the Transportation Systems Center in Cambridge, Massachusetts. The Department cannot respond to inquiries about the performance of individual flights.

However, information on the performance of specific flights is displayed on the Computerized Reservations Systems used by most airlines and travel agencies. Each of the reporting carriers' flights has a one-digit code between 0 and 9 representing that flight's percentage of on-time operations for the latest reported month. For example, "8" means that flight arrived on time (within 15 minutes) between 80% and 89.9% of the time during the latest reported month. As with the data reported to DOT, the figures do not include delays caused by mechanical problems reported to the FAA.

JULY 1991
AIR TRAVEL CONSUMER REPORT

TABLE 1. OVERALL PERCENTAGE OF REPORTED FLIGHT OPERATIONS ARRIVING ON TIME BY CARRIER

CARRIER A/	AT 31 REPORTABLE AIRPORTS B/ NUMBER OF AIRPORTS REPORTED	AT 31 REPORTABLE AIRPORTS B/ PERCENT OF ARRIVALS ON TIME D/	AT ALL REPORTED AIRPORTS C/ NUMBER OF AIRPORTS REPORTED	AT ALL REPORTED AIRPORTS C/ PERCENT OF ARRIVALS ON TIME D/
SOUTHWEST S/	9	90.0	34	91.2
MIDWAY AIRLINES S/	17	88.2	28	90.8
NORTHWEST S/	29	89.7	102	90.0
ALASKA S/	5	88.6	31	88.8
AMERICA WEST S/	20	86.6	52	87.7
AMERICAN S/	31	84.1	116	85.1
USAIR S/	30	82.3	118	83.0
UNITED S/	31	82.1	118	82.6
DELTA S/	31	81.2	133	82.0
CONTINENTAL S/	27	79.9	93	81.7
TWA S/	29	80.1	71	80.2
PAN AMERICAN S/	21	80.4	31	80.0
TOTAL		83.4		84.5

JULY 1991

AIR TRAVEL CONSUMER REPORT

TABLE 1A. OVERALL PERCENTAGE OF REPORTED FLIGHT OPERATIONS ARRIVING ON TIME AND CARRIER RANK, BY MONTH, QUARTER, AND DATA BASE TO DATE

CARRIER	3RD QUARTER JUL-SEP 90		4TH QUARTER OCT-DEC 90		1ST QUARTER JAN-MAR 91		2ND QUARTER APR-JUN 91		MAY 91		JUN 91		JUL 91		12 MONTHS AUG90-JUL91		DATA BASE TO DATE SEP 87-JUL 91	
	%	RANK	%	RANK	%	RANK	%	RANK	%	RANK	%	RANK	%	RANK	%	RANK	%	RANK
ALASKA	80.2	(9)	75.2	(10)	80.1	(5)	89.5	(1)	90.6	(1)	89.0	(4)	88.6	(4)	81.8	(7)	80.0	(5)
AMERICA WEST	87.1	(1)	79.2	(5)	76.6	(8)	87.7	(4)	87.7	(3)	89.7	(3)	87.7	(5)	82.5	(5)	84.1	(1)
AMERICAN	83.6	(3)	77.0	(9)	82.1	(4)	87.2	(5)	86.4	(6)	88.1	(5)	85.1	(6)	82.6	(4)	81.3	(3)
CONTINENTAL	79.2	(10)	78.4	(7)	78.8	(6)	80.9	(11)	81.8	(10)	81.4	(12)	81.7	(10)	79.9	(9)	78.3	(10)
DELTA	78.1	(12)	77.2	(8)	77.2	(7)	81.7	(10)	81.9	(9)	82.3	(9)	82.0	(9)	79.0	(11)	78.6	(8)
EASTERN *	82.7	(4)	81.0	(4)	----	--	----	--	----	--	----	--	----	--	81.8	(6)	79.5	(7)
MIDWAY **	----	--	----	--	72.5	(9)	88.3	(2)	87.7	(2)	92.6	(1)	90.8	(2)	81.2	(8)	81.2	(4)
NORTHWEST	82.5	(6)	82.5	(3)	82.9	(2)	87.8	(3)	86.9	(5)	90.1	(2)	90.0	(3)	84.6	(1)	79.5	(6)
PAN AMERICAN	82.5	(5)	85.6	(1)	82.8	(3)	85.1	(7)	87.5	(4)	83.6	(8)	80.0	(12)	84.1	(2)	78.5	(9)
SOUTHWEST	84.4	(2)	74.9	(11)	72.1	(11)	84.1	(8)	84.1	(8)	88.0	(6)	91.2	(1)	79.5	(10)	82.1	(2)
TWA	78.9	(11)	73.7	(12)	70.1	(12)	82.1	(9)	80.0	(11)	81.6	(11)	80.2	(11)	76.5	(13)	76.7	(12)
UNITED	80.4	(8)	78.7	(6)	72.3	(10)	77.9	(12)	77.0	(12)	81.9	(10)	82.6	(8)	77.6	(12)	75.4	(13)
USAIR	81.2	(7)	83.3	(2)	83.5	(1)	86.0	(6)	84.3	(7)	85.3	(7)	83.0	(7)	83.6	(3)	77.9	(11)
TOTAL	81.3		79.1		78.5		84.1		83.5		85.3		84.5		81.0		78.7	

* EASTERN AIR LINES CEASED OPERATIONS ON JANUARY 19, 1991; THE ON-TIME PERFORMANCE STATISTICS INCLUDE EASTERN'S DATA THROUGH DECEMBER 31, 1990.

** MIDWAY AIRLINES BEGAN REPORTING ITS FLIGHT DATA ON JANUARY 1, 1991.

JULY 1991
AIR TRAVEL CONSUMER REPORT

TABLE 2. NUMBER OF REPORTED FLIGHT ARRIVALS AND PERCENTAGE ARRIVING ON TIME D/
BY CARRIER AND AIRPORT (REPORTABLE AIRPORTS ONLY)

ARRIVAL AIRPORT

CARRIER	ATL		BOS		BWI		CLT		DCA		DEN		DFW		DTW	
	# OF ARR.	% ON TIME	# OF ARR.	% ON TIME	# OF ARR.	% ON TIME	# OF ARR.	% ON TIME	# OF ARR.	% ON TIME	# OF ARR.	% ON TIME	# OF ARR.	% ON TIME	# OF ARR.	% ON TIME
AA	628	82.6	754	82.4	437	79.9	114	84.2	677	82.4	416	81.0	11729	85.1	439	89.1
AS	H/		H/		H/		H/		H/		H/		H/		H/	
CO	602	84.2	816	83.3	125	92.8	H/		572	75.9	4818	78.8	387	85.8	415	81.9
DL	13450	79.2	1412	80.0	[illegible]	77.9	172	78.5	742	79.2	506	78.5	7469	85.8	455	80.2
HP	H/		85	68.2	89	87.4	H/		60	85.0	168	88.7	206	85.4	H/	
ML	130	90.0	141	95.0	H/		H/		156	90.4	92	85.9	139	91.4	236	89.8
NW	483	86.5	1002	82.1	174	88.5	H/		1527	87.1	268	87.7	314	90.4	7648	93.9
PA	115	70.4	599	90.3	38	57.9	58	81.0	626	86.6	61	82.0	88	85.2	177	83.1
TW	201	85.6	248	70.6	166	76.5	84	82.1	369	78.9	240	74.6	271	78.2	208	81.3
UA	341	78.2	612	81.0	202	78.7	144	75.7	386	87.3	5386	83.6	365	84.7	311	88.8
US	522	78.2	2051	84.2	3468	85.1	10026	82.8	2137	88.2	153	73.9	262	77.1	483	82.6
WN	H/		H/		H/		H/		H/		H/		H/		180	90.6
TOTAL	16472	78.8	7720	82.7	5034	83.4	10598	82.6	7252	84.3	11908	81.3	21230	85.3	10532	91.3

JULY 1991
AIR TRAVEL CONSUMER REPORT

TABLE 2. NUMBER OF REPORTED FLIGHT ARRIVALS AND PERCENTAGE ARRIVING ON TIME D/
BY CARRIER AND AIRPORT (REPORTABLE AIRPORTS ONLY)

ARRIVAL AIRPORT

CARRIER	EWR		IAD		IAH		JFK		LAS		LAX		LGA		MCI	
	# OF ARR.	% ON TIME	# OF ARR.	% ON TIME	# OF ARR.	% ON TIME	# OF ARR.	% ON TIME	# OF ARR.	% ON TIME	# OF ARR.	% ON TIME	# OF ARR.	% ON TIME	# OF ARR.	% ON TIME
AA	745	79.6	226	82.3	528	87.1	766	75.8	422	87.2	1553	81.8	1006	76.3	407	90.9
AS	H/		H/		H/		H/		H/		589	85.9	H/		H/	
CO	4801	76.1	141	83.0	5874	84.2	H/		299	86.0	769	71.5	1324	77.2	372	85.5
DL	875	75.7	203	83.4	481	78.8	183	74.9	662	83.5	2734	74.6	1051	75.0	514	87.7
HP	88	69.3	H/		102	88.2	186	92.8	4119	87.1	849	82.4	24	83.3	204	88.2
ML	H/		H/		H/		H/		59	94.9	145	96.6	247	82.2	182	94.4
NW	808	82.9	175	93.1	56	92.9	28	39.3	238	84.0	677	80.5	664	84.0	319	93.4
PA	84	57.1	H/		116	83.6	1028	76.2	H/		288	80.6	1038	88.3	28	82.1
TW	159	83.5	125	77.6	H/		1220	71.7	147	77.6	380	64.5	472	75.6	275	80.7
UA	819	77.0	2989	82.9	173	80.9	265	75.1	324	78.4	3079	77.5	687	78.7	293	85.0
US	1705	80.9	237	91.1	265	73.8	357	74.5	455	79.3	1613	72.8	2328	80.8	871	87.1
WN	H/		H/		153	90.2	H/		1411	93.1	1193	88.3	H/		686	95.3
TOTAL	9884	77.3	4098	83.7	7548	83.9	4033	74.5	8136	86.8	13869	78.2	8841	79.8	4131	89.0

JULY 1991
AIR TRAVEL CONSUMER REPORT

TABLE 2. NUMBER OF REPORTED FLIGHT ARRIVALS AND PERCENTAGE ARRIVING ON TIME D/
BY CARRIER AND AIRPORT (REPORTABLE AIRPORTS ONLY)

ARRIVAL AIRPORT

CARRIER	MCO		MEM		MIA		MSP		ORD		PHL		PHX		PIT	
	# OF ARR.	% ON TIME	# OF ARR.	% ON TIME	# OF ARR.	% ON TIME	# OF ARR.	% ON TIME	# OF ARR.	% ON TIME	# OF ARR.	% ON TIME	# OF ARR.	% ON TIME	# OF ARR.	% ON TIME
AA	472	80.3	204	85.8	1847	75.3	308	86.0	8585	85.7	563	81.3	345	84.1	293	82.6
AS	H/		H/		H/		H/		H/		H/		240	97.1	H/	
CO	460	75.0	H/		465	74.0	249	84.7	583	81.5	252	82.1	232	84.9	187	77.5
DL	2493	79.5	594	85.4	683	73.5	337	84.3	841	81.7	604	79.8	719	89.8	239	87.0
HP	H/		H/		H/		116	87.1	202	81.7	H/		5614	89.3	H/	
ML	137	83.2	H/		60	85.0	230	84.3	H/		184	83.2	60	93.3	H/	
NW	501	84.0	3733	93.4	331	83.4	7346	89.7	805	87.8	403	87.3	348	92.2	174	91.4
PA	254	76.0	H/		1360	75.7	30	70.0	59	81.4	H/		H/		H/	
TW	337	72.4	H/		236	70.3	189	77.9	310	85.8	222	63.5	234	76.5	206	82.5
UA	534	79.2	149	89.9	236	60.6	449	86.0	11502	86.9	461	79.0	343	83.1	113	76.1
US	1560	82.6	195	89.2	1149	78.4	176	80.7	532	81.6	4287	81.4	519	85.4	8966	84.9
WN	H/		H/		N/		H/		H/		H/		3436	89.9	H/	
TOTAL	6748	79.9	4875	91.8	6287	75.4	9440	88.4	23419	86.0	6976	80.9	12090	88.9	10178	84.7

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TABLE 2. NUMBER OF REPORTED FLIGHT ARRIVALS AND PERCENTAGE ARRIVING ON TIME D/ BY CARRIER AND AIRPORT (REPORTABLE AIRPORTS ONLY)

ARRIVAL AIRPORT

CARRIER	RDU # OF ARR.	RDU % ON TIME	SAN # OF ARR.	SAN % ON TIME	SEA # OF ARR.	SEA % ON TIME	SFO # OF ARR.	SFO % ON TIME	SLC # OF ARR.	SLC % ON TIME	STL # OF ARR.	STL % ON TIME	TPA # OF ARR.	TPA % ON TIME
AA	3628	88.6	628	87.1	495	85.1	612	79.6	300	89.0	396	83.8	373	72.1
AS	H/		223	87.4	2271	90.3	626	81.9	H/		H/		H/	
CO	H/		232	78.0	392	75.8	518	70.8	138	83.3	86	90.7	413	86.4
DL	415	84.6	584	82.9	753	78.5	1031	74.0	4742	88.0	293	84.0	936	81.9
HP	H/		487	87.1	283	79.9	471	73.5	194	93.3	129	78.7	H/	
ML	H/		H/		H/		H/		H/		167	82.0	118	89.8
NW	H/		191	89.0	732	83.5	479	81.6	88	87.5	357	88.5	390	87.4
PA	H/		H/		H/		143	76.2	29	62.1	H/		135	63.0
TW	114	85.1	113	60.2	188	74.2	303	59.4	86	68.6	7806	85.9	329	73.3
UA	108	83.3	614	80.0	1794	82.2	5021	75.4	282	72.7	304	81.3	207	76.3
US	931	88.5	629	83.5	333	80.5	1212	72.4	H/		222	83.8	1566	77.8
WN	H/		1323	88.4	H/		524	77.8	H/		1124	91.1	H/	
TOTAL	4898	87.8	5022	84.9	7251	83.7	10940	75.2	5859	87.0	10884	86.1	4467	79.3

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TABLE 3. PERCENTAGE OF ALL CARRIERS' REPORTED FLIGHT OPERATIONS ARRIVING ON TIME D/
BY AIRPORT AND TIME OF DAY (REPORTABLE AIRPORTS ONLY)

SCHEDULED ARRIVAL TIME	ATL	BOS	BWI	CLT	DCA	DEN	DFW	DTW	EWR	IAD	IAH	JFK	LAS	LAX	LGA	MCI
	ARRIVAL AIRPORT															
600 - 659 AM	J/	79.3	89.7	97.8	J/	J/	98.4	94.4	79.6	80.8	98.8	77.8	100.0	95.8	J/	J/
700 - 759 AM	90.5	93.4	78.4	88.6	90.8	88.9	96.0	J/	76.9	100.0	97.7	74.1	89.2	87.6	98.6	100.0
800 - 859 AM	94.2	92.6	89.5	78.8	89.5	87.6	94.2	97.6	87.8	91.6	93.2	97.3	95.2	87.8	88.2	95.0
900 - 959 AM	88.2	91.0	94.2	78.8	90.8	82.7	88.8	91.9	86.1	91.9	86.9	100.0	91.2	77.5	90.9	94.8
1000 - 1059 AM	86.5	95.0	84.2	87.5	93.3	76.2	93.6	91.1	89.8	84.4	92.8	90.6	88.1	82.8	87.1	94.4
1100 - 1159 AM	83.1	90.0	88.7	84.9	90.5	85.8	85.9	95.9	91.4	93.3	88.6	J/	93.7	77.9	89.3	96.3
1200 - 1259 PM	83.3	89.0	94.4	92.6	91.8	85.6	89.4	95.6	88.1	91.1	87.2	96.8	82.2	77.6	91.2	91.1
100 - 159 PM	91.1	93.5	90.6	89.2	91.9	88.9	84.3	95.6	89.3	91.6	74.2	90.9	84.7	79.4	85.9	89.0
200 - 259 PM	84.1	88.6	92.8	88.6	86.4	85.1	83.6	94.9	82.1	87.7	82.9	88.9	82.8	79.5	85.7	89.5
300 - 359 PM	74.0	88.2	83.0	86.0	87.9	85.4	87.9	92.2	79.9	85.9	90.7	72.8	83.8	83.2	79.7	90.3
400 - 459 PM	83.8	78.6	79.2	80.0	79.5	80.8	82.1	93.8	69.7	82.9	84.5	68.7	85.0	77.8	70.7	88.9
500 - 559 PM	75.6	74.5	79.8	73.4	78.5	75.9	82.4	90.4	66.8	81.3	80.3	59.4	87.3	86.6	71.8	90.1
600 - 659 PM	69.4	76.7	77.4	81.7	78.9	79.1	74.2	89.2	69.0	79.7	81.2	72.3	87.5	77.4	71.7	87.2
700 - 759 PM	74.6	70.9	75.6	79.5	78.4	74.9	79.7	85.6	61.0	72.5	76.5	76.3	91.2	74.3	70.4	79.6
800 - 859 PM	80.8	75.1	76.4	73.0	76.5	65.8	77.6	88.8	69.8	68.2	69.7	79.0	87.5	71.8	73.5	87.8
900 - 959 PM	75.4	71.8	69.2	75.6	75.2	75.0	80.4	85.2	71.1	72.5	78.7	82.7	85.2	63.2	88.8	78.9
1000 - 1059 PM	79.8	80.9	77.7	79.0	78.2	76.6	84.0	80.7	72.9	86.1	74.2	72.8	81.6	73.9	72.3	84.8
1100 - 559 AM	76.6	78.0	84.5	80.0	82.1	91.9	90.7	80.1	79.8	80.5	79.2	84.4	85.0	86.3	77.3	91.1
TOTAL, ALL ARRIVALS, BY AIRPORT	79.8	82.7	83.4	82.6	84.3	81.3	85.3	91.3	77.3	83.7	83.9	74.5	86.8	78.2	79.8	89.0

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TABLE 3. PERCENTAGE OF ALL CARRIERS' REPORTED FLIGHT OPERATIONS ARRIVING ON TIME D/
BY AIRPORT AND TIME OF DAY (REPORTABLE AIRPORTS ONLY)

SCHEDULED ARRIVAL TIME	ARRIVAL AIRPORT															
	MCO	MEM	MIA	MSP	ORD	PHL	PHX	PIT	RDU	SAN	SEA	SFO	SLC	STL	TPA	TOTAL
600 - 659 AM	83.3	J/	88.4	85.6	94.3	86.9	97.9	91.2	J/	70.0	88.5	J/	J/	90.9	77.4	88.1
700 - 759 AM	97.7	97.1	96.2	95.8	94.5	83.9	95.2	93.7	100.0	90.9	96.6	94.2	63.9	98.4	96.3	92.4
800 - 859 AM	95.2	96.4	94.5	93.8	91.6	84.6	94.6	89.7	92.9	91.2	94.0	83.7	93.7	84.3	95.5	91.4
900 - 959 AM	92.4	91.8	94.8	95.8	91.5	87.9	91.4	80.7	94.5	91.9	96.9	84.0	86.7	90.9	93.9	88.2
1000 - 1059 AM	89.0	87.4	86.8	88.6	90.1	90.2	88.9	82.0	75.9	86.3	93.3	70.6	92.9	87.4	88.6	87.9
1100 - 1159 AM	85.1	88.3	78.5	93.4	92.7	95.2	90.8	92.7	83.9	92.4	76.4	67.1	91.5	88.9	86.5	86.8
1200 - 1259 PM	90.4	97.9	85.2	91.5	89.9	90.3	93.9	94.4	96.4	85.3	80.6	58.3	92.9	85.1	88.5	86.8
100 - 159 PM	90.7	95.6	81.3	87.7	92.1	86.6	88.1	90.8	92.3	80.3	79.8	70.0	89.0	90.0	83.3	87.8
200 - 259 PM	76.1	94.8	73.6	94.7	91.1	83.3	87.0	92.4	91.8	86.2	82.7	73.1	92.2	88.3	71.9	85.7
300 - 359 PM	74.0	88.9	72.7	90.2	84.4	84.3	89.8	87.8	95.6	81.2	81.7	81.2	87.6	90.9	78.1	83.9
400 - 459 PM	76.1	96.7	73.4	88.7	85.3	75.4	86.8	81.7	91.1	84.7	87.0	84.6	74.7	82.7	79.6	79.7
500 - 559 PM	72.0	86.8	64.9	86.6	80.1	73.2	83.4	80.1	83.9	85.4	84.0	80.8	88.1	82.2	77.9	79.3
600 - 659 PM	71.5	88.7	60.8	84.9	76.4	76.3	88.0	85.8	80.1	89.5	88.9	82.9	91.3	83.6	65.3	79.7
700 - 759 PM	72.6	83.4	65.9	91.3	75.6	68.7	84.9	76.8	82.2	80.7	83.5	78.1	87.1	84.2	62.3	78.0
800 - 859 PM	60.0	71.2	61.7	81.2	75.8	54.2	82.6	75.7	76.3	80.4	78.6	72.2	76.5	84.4	63.1	74.9
900 - 959 PM	71.7	82.5	67.7	84.0	79.0	72.8	87.5	79.5	76.0	84.9	83.2	70.5	62.1	83.8	73.7	76.1
1000 - 1059 PM	81.9	77.4	72.1	79.6	75.3	80.7	86.4	77.3	76.5	80.7	84.2	76.6	100.0	80.0	74.6	78.4
1100 - 559 AM	81.9	96.4	77.0	80.7	90.0	88.7	82.6	87.0	82.1	80.5	82.1	84.5	82.2	82.2	73.7	83.8
TOTAL, ALL ARRIVALS, BY AIRPORT	79.9	91.8	75.4	88.4	86.0	80.9	88.9	84.7	87.8	84.9	83.7	75.2	87.0	86.1	79.3	83.4

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TABLE 4. PERCENTAGE OF ALL CARRIERS' REPORTED FLIGHT OPERATIONS DEPARTING ON TIME E/ BY AIRPORT AND TIME OF DAY (REPORTABLE AIRPORTS ONLY)

SCHEDULED DEPARTURE TIME	DEPARTURE AIRPORT ATL	BOS	BWI	CLT	DCA	DEN	DFW	DTW	EWR	IAD	IAH	JFK	LAS	LAX	LGA	MCI
600 - 659 AM	93.9	96.4	100.0	98.8	97.8	98.1	96.6	95.8	95.4	97.8	98.3	96.7	97.9	95.3	96.9	99.0
700 - 759 AM	95.3	92.8	97.3	96.5	95.0	95.5	98.3	95.5	93.7	98.7	95.6	92.8	96.3	94.6	93.9	98.9
800 - 859 AM	95.6	95.6	95.3	91.1	94.8	93.6	96.6	98.5	88.0	98.4	94.2	88.9	95.4	90.0	93.8	96.9
900 - 959 AM	91.5	93.6	92.8	87.6	94.2	92.4	95.4	94.8	87.5	92.2	92.6	94.2	91.2	84.4	92.7	94.9
1000 - 1059 AM	92.6	94.3	96.3	94.7	96.8	88.7	90.4	94.0	89.8	91.7	91.0	94.2	84.0	76.4	89.9	95.2
1100 - 1159 AM	89.3	97.1	J/	0	94.2	89.0	94.0	95.1	94.3	88.3	83.1	91.9	91.8	78.7	90.3	98.9
1200 - 1259 PM	91.9	92.3	91.9	9.6	91.9	89.2	91.8	94.0	94.6	93.8	92.4	93.1	93.0	79.2	92.5	95.3
100 - 159 PM	89.4	91.1	98.3	92.5	94.3	90.1	90.0	95.9	90.1	92.6	87.2	95.5	87.4	85.4	92.2	88.7
200 - 259 PM	89.0	93.4	92.1	90.3	91.0	86.8	91.0	91.1	88.5	88.0	85.1	88.6	87.2	82.7	87.6	89.2
300 - 359 PM	87.2	85.0	87.6	85.1	84.9	87.2	89.3	88.5	80.6	86.9	89.3	83.1	90.5	85.3	85.8	91.9
400 - 459 PM	71.3	86.1	85.0	82.9	83.8	81.7	87.9	89.8	81.3	90.5	89.5	70.1	86.7	87.4	84.5	92.8
500 - 559 PM	79.4	76.5	74.3	74.0	83.2	82.5	87.0	89.3	66.4	70.6	79.7	66.5	84.2	83.5	78.9	92.4
600 - 659 PM	74.3	78.1	94.4	74.8	81.1	79.9	84.0	90.1	70.6	82.9	83.2	47.8	86.5	86.1	72.7	92.2
700 - 759 PM	84.2	75.3	79.6	83.1	78.8	80.1	81.8	88.3	65.6	89.5	87.4	74.8	82.9	83.3	75.9	84.1
800 - 859 PM	81.4	76.6	82.6	84.1	80.9	75.9	84.6	83.5	67.8	77.0	80.6	80.0	86.7	82.3	74.0	92.6
900 - 959 PM	95.5	90.4	82.2	77.9	79.9	J/	83.9	83.8	69.6	73.9	95.8	86.1	92.5	81.6	77.6	100.0
1000 - 1059 PM	79.5	75.9	64.4	J/	J/	96.7	86.3	J/	78.9	J/	83.7	78.8	89.8	85.9	70.9	72.2
1100 - 559 AM	82.3	80.6	100.0	100.0	J/	100.0	90.5	96.2	100.0	88.5	86.4	59.3	85.3	92.4	J/	80.6
TOTAL, ALL DEPARTURES, BY AIRPORT	86.0	88.2	88.8	86.5	89.1	86.3	90.2	91.5	83.0	87.6	87.6	74.7	88.7	85.5	86.7	93.3

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TABLE 4. PERCENTAGE OF ALL CARRIERS' REPORTED FLIGHT OPERATIONS DEPARTING ON TIME E/ BY AIRPORT AND TIME OF DAY (REPORTABLE AIRPORTS ONLY)

SCHEDULED DEPARTURE TIME	DEPARTURE AIRPORT															
	MCO	MEM	MIA	MSP	ORD	PHL	PHX	PIT	RDU	SAN	SEA	SFO	SLC	STL	TPA	TOTAL
600 - 659 AM	89.8	100.0	96.5	04.5	96.2	99.0	96.9	97.5	96.4	96.4	95.2	95.6	93.1	88.1	95.6	96.2
700 - 759 AM	96.6	99.1	95.1	93.0	94.4	95.9	94.6	94.1	97.0	95.5	90.1	96.5	93.5	95.1	95.7	95.0
800 - 859 AM	94.4	94.2	94.9	94.5	96.1	92.8	90.6	93.3	96.3	96.8	90.6	90.6	93.6	95.7	96.0	93.6
900 - 959 AM	94.4	95.8	95.5	93.7	93.4	89.9	91.0	90.7	95.1	86.2	91.2	91.6	91.3	92.1	96.2	92.3
1000 - 1059 AM	95.3	90.3	94.0	94.9	92.5	89.6	87.5	92.3	94.5	76.6	90.5	88.3	90.7	91.8	95.0	90.6
1100 - 1159 AM	94.0	100.0	90.1	92.0	93.8	100.0	88.9	90.0	100.0	84.0	90.9	76.0	90.2	92.7	91.6	90.2
1200 - 1259 PM	88.4	91.7	90.1	91.5	92.6	91.5	89.5	87.1	100.0	88.0	80.4	75.4	92.5	87.3	92.4	89.3
100 - 159 PM	93.2	93.0	87.3	88.5	92.8	90.5	91.1	91.4	94.3	89.1	78.8	70.5	92.8	90.3	91.8	89.1
200 - 259 PM	82.1	95.2	82.2	92.0	91.4	83.1	82.8	91.4	91.7	86.6	82.7	75.1	93.7	92.9	80.9	88.6
300 - 359 PM	82.7	82.5	78.8	94.2	88.5	85.2	84.8	83.3	89.7	92.6	83.1	80.4	96.2	90.5	88.8	87.0
400 - 459 PM	90.0	98.3	82.4	94.5	87.1	80.1	87.3	83.6	95.6	81.4	91.0	83.7	88.9	89.1	95.1	84.8
500 - 559 PM	82.0	92.2	82.6	88.2	83.9	81.0	81.2	80.5	89.8	84.8	94.0	88.3	92.3	89.6	88.2	81.6
600 - 659 PM	81.3	95.2	81.4	85.4	81.1	83.9	83.4	79.8	77.2	86.0	83.9	84.5	93.3	84.9	90.5	81.0
700 - 759 PM	81.0	89.1	80.5	86.0	76.4	77.9	85.3	89.1	82.0	84.2	89.6	79.9	89.4	89.2	82.6	82.0
800 - 859 PM	76.6	86.9	89.3	87.6	80.3	80.1	84.7	79.3	84.3	79.8	77.9	74.1	J/	86.4	76.9	81.6
900 - 959 PM	71.2	J/	78.9	87.0	74.1	J/	83.3	77.1	88.6	91.4	73.1	76.9	77.3	85.2	90.6	79.9
1000 - 1059 PM	75.9	93.1	J/	88.0	81.6	J/	85.7	91.3	J/	94.9	91.6	87.3	96.3	92.2	86.4	84.9
1100 - 559 AM	93.5	J/	69.0	J/	91.4	100.0	94.7	J/	83.3	98.9	92.1	95.7	91.1	J/	98.2	89.6
TOTAL, ALL DEPARTURES, BY AIRPORT	87.3	92.8	87.5	90.4	88.9	86.9	88.3	86.4	90.9	88.6	87.4	83.6	89.8	89.8	91.2	87.8

NOTE: DEPARTURES LESS THAN 15 MINUTES AFTER SCHEDULED DEPARTURE TIME ARE CONSIDERED ON TIME; CANCELLED FLIGHTS COUNT AS LATE DEPARTURES; DIVERTED FLIGHTS ARE ON TIME OR LATE, DEPENDING ON ACTUAL DEPARTURE TIME.

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TABLE 5. LIST OF REGULARLY SCHEDULED FLIGHTS 1/ ARRIVING LATE 80% OF THE TIME OR MORE

CARRIER	FLIGHT NUMBER	ORIGIN-DESTIN. AIRPORTS	SCHEDULED DEPARTURE TIME	NUMBER OF OPERATIONS REPORTED	PERCENTAGE OF FLIGHT OPERATIONS ARRIVING 15 MINUTES LATE OR MORE 2/	NO. OF MIN. LATE AVERAGE	NO. OF MIN. LATE MEDIAN
PA	787	BDL-MIA	0745	17	100.00		
PA	784	MIA-BDL	1855	17	100.00		
TW	733	BWI-SFO	1755	30	96.67	101	101
TW	108	STL-PHL	1855	30	93.33	33	28
TW	721	STL-LAX	1837	26	92.31	49	46
DL	57	LAX-ANC	1050	23	86.96	20	20
DL	148	LAX-ATL	1220	31	83.87	27	27
US	151	SFO-LAX	1000	31	83.87	22	20
TW	805	JFK-HOU	1803	30	83.33	45	35
US	151	LAX-TPA	1155	30	83.33	28	24
TW	881	JFK-MSY	1810	29	82.76	55	41
DL	1088	DFW-ATL	1300	31	80.65	31	24
UA	376	SFO-MIA	1335	31	80.65	33	28
DL	100	LAX-ATL	0840	30	80.00	27	27
DL	1000	LAX-SFO	1000	30	80.00	33	37
UA	848	LAX-SFO	1100	30	80.00	30	28
US	777	CHS-CLT	1615	25	80.00	23	20

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TABLE 6. NUMBER AND PERCENTAGE OF REGULARLY SCHEDULED FLIGHTS 1/ ARRIVING LATE 70% OF THE TIME OR MORE

CARRIER	NUMBER OF REGULARLY SCHEDULED FLIGHTS FOR WHICH CARRIER REPORTED DATA	REGULARLY SCHEDULED FLIGHTS LATE 70% OF THE TIME OR MORE D/	
		NUMBER	PERCENTAGE
PAN AMERICAN	251	6	2.4
TWA	727	12	1.7
DELTA	2480	19	0.8
CONTINENTAL	1298	9	0.7
USAIR	2558	12	0.5
MIDWAY AIRLINES	240	1	0.4
ALASKA	319	1	0.3
AMERICA WEST	712	2	0.3
UNITED	1831	6	0.3
AMERICAN	2180	2	0.1
SOUTHWEST	1173	1	0.1
NORTHWEST	1387		0.0
TOTAL	15257	71	0.5

FOOTNOTES FOR TABLES 1 THROUGH 6 (FLIGHT DELAYS)

A — See Appendix for list of carrier codes.

B — See Appendix for list of 31 airports for which data must be reported. Data include all reported domestic flight operations to the 31 reportable airports (e.g., Albany to Atlanta, Toledo to Boston).

C — All domestic airports for which carrier reported data. Data include all reported domestic flight operations to the 31 reportable airports and from those aiprorts to other destinations (e.g., Albany to Atlanta, and Atlanta to Albany); in addition, for carriers that reported data for their entire domestic systems, the data also include all reported domestic flight operations between non-required airports (e.g., Albany to Toledo).

D — "On time" means an arrival less than 15 minutes after scheduled arrival time; cancelled and diverted flights are not considered on-time arrivals.

E — "On time" means a departure less than 15 minutes after scheduled departure time; cancelled flights are not considered on-time departures; diverted flights may be on time or late departures, depending on actual departure time.

F — Incomplete data; percentage based on operations reported.

G — Carrier did not report useable data.

H — Carrier did not serve airport.

I — Regularly scheduled flights are those for which the carrier reported at least 15 operations for the month.

J — Blanks in any time interval in Tables 3 and 4 indicate no arrival operations (Table 3) or departure operations (Table 4) for domestic flights of the reporting carriers during that time period. Other carriers, including code-sharing partners, may operate during those periods.

S — Carrier reported data for entire domestic system.

V — Carrier reported data voluntarily.

APPENDIX

NOTE: The Department of Transportation has screened the reporting carriers' data for completeness and verified all arithmetic data elements computed by the carriers (e.g., length of delay). Individual flight operations records with incorrect calculations, erroneous city-pairs, or missing data elements were rejected and excluded from the data base; such rejected records accounted for less than 0.01% of the flight operations records submitted. Any errors in the data base with respect to basic flight data -- non-computed data elements such as flight numbers, scheduled and actual arrival/departure times, days of operation -- are the responsibility of the reporting carrier.

Airports Covered by the Rule

Atlanta. Hartsfield	ATL
Baltimore. Balt-Wash International	BWI
Boston. Logan International	BOS
Charlotte. Douglas	CLT
Chicago. O'Hare	ORD
Dallas-Fort Worth International	DFW
Denver. Stapleton International	DEN
Detroit. Metro Wayne County	DTW
Houston Intercontinental	IAH
Kansas City International	MCI
Las Vegas. McCarran International	LAS
Los Angeles International	LAX
Memphis International	MEM
Miami International	MIA
Minneapolis-St. Paul International	MSP
Newark International	EWR
New York. JFK International	JFK
New York. LaGuardia	LGA
Orlando International	MCO
Philadelphia International	PHL
Phoenix. Sky Harbor International	PHX
Pittsburgh. Greater International	PIT
Raleigh-Durham International	RDU
St. Louis. Lambert	STL
Salt Lake City International	SLC
San Diego Intl. Lindbergh Field	SAN
San Francisco International	SFO
Seattle-Tacoma International	SEA
Tampa International	TPA
Washington. Dulles International	IAD
Washington. National	DCA

Air Carriers Required to Report Data to DOT and to CRS Vendors

AS	Alaska Airlines
AA	American Airlines
HP	America West Airlines
CO	Continental Airlines
DL	Delta Air Lines
ML	Midway Airlines
NW	Northwest Airlines
PA	Pan American World Airways
WN	Southwest Airlines
TW	Trans World Airlines
US	USAir
UA	United

MISHANDLED BAGGAGE

This section gives the rate of mishandled-baggage reports per 1,000 passengers by carrier and for the industry. The rate is based on the total number of reports each carrier received from passengers concerning lost, damaged, delayed or pilfered baggage. Each carrier uses a different system to track baggage problems and thus variations exist in what is reported to DOT. Some carriers have more comprehensive reporting systems than others. In order to establish a uniform system from which useful comparisons can be made, reports filed with carriers about courtesy tracers, voluntary separations, carry-on baggage and double counts are not included in calculating the rate of complaint reports. This allows the data for each carrier to be listed in rank order, based on the net number of reports filed per 1,000 passengers. Like the data on flight delays in the previous section, these baggage statistics are filed with DOT by the 12 largest U.S. airlines on a monthly basis as required by 14 C.F.R. 234. The report is based on each carrier's systemwide domestic passenger service.

OFFICE OF CONSUMER AFFAIRS
U.S. DEPARTMENT OF TRANSPORTATION

JULY
MISHANDLED BAGGAGE REPORTS
FILED BY PASSENGERS

		JULY 1991			JULY 1990		
JULY '91 RANK	U.S. AIRLINES	NET NO. OF BAGGAGE REPORTS	PASSENGERS	REPORTS PER 1,000 PASSENGERS	NET NO. OF BAGGAGE REPORTS	PASSENGERS	REPORTS PER 1,000 PASSENGERS
1	Midway	1,070	393,282	2.72			N.A
2	American	27,583	6,785,896	4.06	35,811	6,224,380	5.75
3	Southwest	9,476	2,224,904	4.26	8,507	2,050,598	4.15
4	Northwest	16,130	3,446,827	4.68	22,745	3,435,309	6.62
5	America West	7,889	1,612,950	4.89	10,360	1,340,084	7.73
6	Pan Am	3,496	711,941	4.91	4,778	761,094	6.28
7	USAir	26,006	4,996,348	5.21	33,975	5,435,454	6.25
8	Continental	18,261	3,507,665	5.21	18,877	3,356,709	5.62
9	United	31,511	5,512,413	5.72	32,231	5,153,259	6.25
10	Trans World	10,748	1,737,117	6.19	16,979	2,018,614	8.41
11	Alaska	3,762	600,223	6.27	3,766	554,269	6.79
12	Delta	35,184	5,042,843	6.98	30,524	5,635,072	5.42
	Total	191,116	36,572,409	5.23	218,553	35,964,842	6.08

NOTE: Passengers Enplaned --For the domestic system only.

Net No. of Reports -- For the domestic system only. These are passenger reports of mishandled baggage, including those that did not subsequently result in claims for compensation. Some carriers have more comprehensive reporting systems than others. To allow fair comparison, reports about courtesy tracers, voluntary separations, carry-on baggage, and double counts have been deducted from the total baggage reports submitted by those carriers offering such services.

OVERSALES

This section furnishes data on the number of passengers who hold confirmed reservations and are denied boarding ("bumped") from a flight because it is oversold. These figures include only passengers whose oversold flight departs without them; they do not include passengers affected by cancelled, delayed or diverted flights.

The report includes U.S. airlines that have revenues over $100 million per year (see footnote on chart for details). It provides system data for scheduled passenger service on domestic flights and data on international flight segments that originate in the United States. Information is displayed for the latest available quarter and for the year to date, for the current period and for the same period in the previous year. The reporting requirement is found in 14 C.F.R. 250.10.

These tables give information by carrier on the number of passengers bumped involuntarily and on the number who voluntarily gave up their seat on an oversold flight in exchange for compensation. Also shown is the rate of involuntary denied boardings per 10,000 passengers. This rate determines the order in which carriers are listed; the airline with the lowest rate appears first. The number and rate of involuntary denied boardings include both passengers who received denied boarding compensation and passengers who did not qualify for compensation because of one of the exceptions in the oversales rule. There are three exceptions: 1) passenger accommodated on another flight scheduled to arrive within one hour of the original flight; 2) passenger fails to comply with ticketing, check-in or reconfirmation procedures; and 3) aircraft of smaller capacity is substituted. Totals appear at the end of each table.

The enplanement figures that are used to calculate the involuntary denied boarding rate do not include "shuttle" service on which reservations are not offered, nor do they include inbound international service, since the rule does not apply to these flights.

OFFICE OF CONSUMER AFFAIRS
U.S. DEPARTMENT OF TRANSPORTATION

PASSENGERS DENIED BOARDING
BY MAJOR/NATIONAL U.S. AIRLINES*

Ranked by Involuntary Denied Boardings per 10,000 Passengers

APRIL through JUNE 1991

APR-JUNE 1991 RANK	U.S. AIRLINES	1991 DENIED BOARDINGS (DB's) VOLUNTARY	1991 DENIED BOARDINGS (DB's) INVOLUNTARY	1991 PASSENGERS BOARDED	1991 INVOLUNTARY DB'S PER 10,000 PSGRS	1990 DENIED BOARDINGS (DB's) VOLUNTARY	1990 DENIED BOARDINGS (DB's) INVOLUNTARY	1990 PASSENGERS BOARDED	1990 INVOLUNTARY DB'S PER 10,000 PSGRS
	MAJORS								
1	American	22,159	330	20,659,855	0.16	26,066	89	18,845,734	0.05
2	Delta	12,196	590	18,532,619	0.32	8,603	739	16,773,741	0.44
3	United	23,255	641	15,141,516	0.42	20,302	350	13,495,325	0.26
4	Northwest	14,670	550	9,348,283	0.59	12,876	735	9,235,653	0.80
5	USAir	11,681	896	14,065,420	0.64	22,978	2,461	15,676,410	1.57
6	Continental	16,975	1,368	9,343,753	1.46	12,126	1,365	8,661,415	1.58
7	America West	12,376	717	4,501,134	1.59	3,938	1,805	3,696,426	4.88
8	Pan Am	3,927	615	2,463,035	2.50	3,907	642	2,962,351	2.17
9	T W A	6,767	1,809	4,765,477	3.80	5,328	2,117	5,869,033	3.61
10	Southwest	8,380	2,199	5,456,290	4.03	6,136	2,405	5,204,140	4.62
	TOTAL MAJORS	132,386	9,715	104,267,382	0.93	122,162	12,708	100,420,428	1.27
	NATIONALS								
1	Westair	622	0	796,468	0.00	0	1,009	580,204	17.39
2	American Trans Air	0	0	93,756	0.00	0	0	46,684	0.00
3	Tower	0	0	73,136	0.00	0	0	49,256	0.00
4	Air Wisconsin	327	4	617,372	0.06	253	5	574,936	0.09
5	Midwest Express	34	2	190,236	0.11	54	11	206,456	0.53
6	Horizon	1	2	58,450	0.34	1	2	51,391	0.39
7	Hawaiian	26	58	784,012	0.74	12	225	1,053,012	2.14
8	Alaska	1,375	198	1,496,102	1.32	2,456	416	1,316,894	3.16
9	Midway	3,552	294	1,319,604	2.23	1,744	247	1,734,722	1.42
10	Markair	59	35	117,769	2.97	71	38	129,331	2.94
11	Aloha	2	939	1,193,784	7.87	6	719	1,095,456	6.56
	TOTAL NATIONALS	5,996	593	5,547,125	1.07	4,591	1,953	5,744,786	3.40
	GRAND TOTAL	138,382	10,308	109,814,507	0.94	126,753	14,661	106,165,214	1.38

* Airlines are grouped based on annual operating revenues. Airlines are classified as Majors if they exceed $1,000,000,000 operating revenue. Nationals are airlines with operating revenues from $100,000,000 through $1,000,000,000.

PASSENGERS DENIED BOARDING BY MAJOR/NATIONAL U.S. AIRLINES*

Ranked by Involuntary Denied Boardings per 10,000 Passengers

JANUARY through JUNE 1991

JAN-JUN 1991 RANK	U.S. AIRLINES	1991 DENIED BOARDINGS (DB's) VOLUNTARY	1991 DENIED BOARDINGS (DB's) INVOLUNTARY	1991 PASSENGERS BOARDED	1991 INVOLUNTARY DB'S PER 10,000 PSGRS	1990 DENIED BOARDINGS (DB's) VOLUNTARY	1990 DENIED BOARDINGS (DB's) INVOLUNTARY	1990 PASSENGERS BOARDED	1990 INVOLUNTARY DB'S PER 10,000 PSGRS
	MAJORS								
1	American	48,300	898	37,458,376	0.24	55,299	297	36,046,983	0.08
2	Delta	27,790	1,586	35,144,412	0.45	23,310	1,928	33,544,947	0.57
3	USAir	25,687	1,720	27,024,213	0.64	58,537	5,806	29,897,919	1.94
4	Northwest	25,174	1,135	17,347,372	0.65	27,691	1,783	17,856,329	1.00
5	United	38,812	1,839	27,441,846	0.67	45,416	937	26,015,522	0.36
6	Continental	29,596	2,719	17,633,772	1.54	25,394	2,774	16,958,749	1.64
7	America West	27,147	2,047	8,671,532	2.36	11,062	6,321	7,256,359	8.71
8	Pan Am	7,662	1,229	4,660,837	2.64	8,955	1,447	5,539,268	2.61
9	Southwest	15,052	3,864	10,690,853	3.61	15,960	5,589	9,633,328	5.80
10	T W A	14,666	3,598	9,112,185	3.95	10,536	3,622	11,002,677	3.29
	TOTAL MAJORS	259,886	20,633	195,185,398	1.06	282,160	30,504	193,752,081	1.57
	NATIONALS								
1	Westair	1,205	0	1,513,121	0.00	0	2,371	1,097,053	21.61
2	American Trans Air	0	0	178,429	0.00	0	0	92,937	0.00
3	Tower	0	0	122,968	0.00	0	0	102,455	0.00
4	Midwest Express	73	2	368,263	0.05	99	18	369,613	0.49
5	Air Wisconsin	535	7	1,091,242	0.06	454	13	1,076,608	0.12
6	Horizon	7	4	107,993	0.37	2	2	94,619	0.21
7	Hawaiian	26	58	784,012	0.74	26	496	2,097,292	2.36
8	Alaska	5,253	549	2,763,992	1.99	4,737	641	2,477,161	2.59
9	Markair	137	70	202,734	3.45	150	83	219,368	3.78
10	Midway	8,637	1,049	2,738,334	3.83	6,472	664	3,389,895	1.96
11	Aloha	13	1,411	2,284,349	6.18	15	1,140	2,212,813	5.15
	TOTAL NATIONALS	15,873	1,739	9,871,068	1.76	11,940	4,288	11,017,001	3.89
	GRAND TOTAL	275,759	22,372	205,056,466	1.09	294,100	34,792	204,769,082	1.70

* Airlines are grouped based on annual operating revenues. Airlines are classified as Majors if they exceed $1,000,000,000 operating revenue. Nationals are airlines with operating revenues from $100,000,000 through $1,000,000,000.

CONSUMER COMPLAINTS

This section summarizes aviation consumer complaints filed with the Department in writing, by telephone or in person. It does not include safety complaints, which are handled by the Federal Aviation Administration. An explanation of each section of the report appears below:

Summary. Page 1 gives the total number of complaints, and also breaks down complaints by industry groups (U.S. airlines, tour operators, etc.). As with most other sections of the report, figures for the current month are compared to the same month in the previous year.

Complaint Categories. Page 2 ranks the categories of complaints (baggage, refunds, etc.). A detailed explanation of each category appears at the end of the Consumer Complaint section of the report.

U.S. Airlines. Page 3 shows the number of complaints against individual U.S. airlines, listed alphabetically and broken down by complaint category.

Incident Date. The next page shows the number of complaints against individual U.S. airlines, listed alphabetically and broken down by the time periods in which the incidents occurred.

Companies Other Than U.S. Airlines. The next several pages break down complaints by complaint category for foreign airlines, tour operators, cargo companies, etc.

Major/National Rankings: The last page ranks the largest U.S. airlines, the Majors and Nationals, according to the rate of complaints per 100,000 passengers. This ranking takes into account airline size when identifying the Major and National carriers against whom the most complaints have been filed.

U.S. DEPARTMENT OF TRANSPORTATION
OFFICE OF CONSUMER AFFAIRS

AIR TRAVEL CONSUMER REPORT

COMPLAINT CATEGORIES *

	JULY 1991			JULY 1990		
	RANKING	COMPLAINTS**	SUB CATEGORY	RANKING	COMPLAINTS**	SUB CATEGORY
FLIGHT PROBLEMS	1	202		1	235	
DELAYS			81			87
CANCELLATIONS			62			75
MISCONNECTIONS			29			50
BAGGAGE	[illegible]	128		2	136	
REFUNDS	[illegible]	92		4	68	
TICKETING/BOARDING	4	87		3	72	
DISABLED			17			18
CUSTOMER SERVICE	5	78		5	65	
FARES	6	42		6	38	
OTHER	7	40		8	21	
FREQUENT FLYER			22			11
OVERSALES	8	36		7	32	
ADVERTISING	9	5		9	6	
SMOKING	10	4		11	3	
TOURS	11	4		10	6	
CREDIT	12	1		12	1	
		----			----	
COMPLAINT TOTAL		719			683	

* A DETAILED EXPLANATION OF THE COMPLAINT CATEGORIES IS ATTACHED.

** INCLUDES FIGURES FOR SUB-CATEGORIES.

U.S. DEPARTMENT OF TRANSPORTATION
OFFICE OF CONSUMER AFFAIRS

AIR TRAVEL CONSUMER REPORT

COMPLAINTS AGAINST U.S.AIRLINES BY COMPLAINT CATEGORY

JULY 1991

U.S. AIRLINES ALPHABETICAL	FLIGHT PROBLEMS	OVER-SALES	TICKETING/ BOARDING	FARES	REFUNDS	BAGGAGE	CUSTOMER SERVICE	SMOKING	ADVER-TISING	CREDIT	TOURS	OTHER	TOTAL
AMERICA WEST AIRLINES	6	2	4	1	6	3	2	0	1	0	0	1	26
AMERICAN AIRLINES	33	5	18	11	4	14	16	0	0	0	1	7	109
CONTINENTAL AIRLINES	17	3	7	4	6	6	6	0	0	0	0	1	50
DELTA AIR LINES	12	1	5	2	7	5	9	0	0	0	1	1	43
EASTERN AIR LINES	0	0	0	0	16	0	0	0	1	0	0	2	19
HAWAIIAN AIRLINES	6	0	1	0	0	4	2	0	0	0	0	0	13
MIDWAY AIRLINES	2	0	1	0	1	1	0	0	0	1	0	0	6
NORTHWEST AIRLINES	17	2	1	1	1	2	3	0	1	0	0	1	29
PAN AM EXPRESS	1	1	0	0	1	2	0	0	0	0	0	0	5
PAN AMERICAN WORLD AIRWAYS	8	4	2	2	4	8	1	0	0	0	0	1	30
SOUTHWEST AIRLINES	2	0	2	0	1	1	3	0	0	0	0	0	9
TRANS WORLD AIRLINES	28	2	7	6	13	20	10	2	0	0	0	9	97
UNITED AIRLINES	33	2	15	9	8	21	17	0	2	0	0	7	114
USAIR	12	3	4	0	0	4	2	0	0	0	0	0	25
OTHER U.S. AIRLINES	14	4	5	1	3	7	5	0	0	0	0	2	41
JULY 1991	191	29	72	37	71	98	76	2	5	1	2	32	616
% OF TOTAL COMPLAINTS	31.0	4.7	11.7	6.0	11.5	15.9	12.3	0.3	0.8	0.2	0.3	5.2	
JULY 1990	208	24	58	32	42	105	51	2	5	1	1	15	542
% OF TOTAL COMPLAINTS	38.4	4.4	10.3	5.9	7.7	19.4	9.4	0.4	0.9	0.2	0.2	2.8	

AIRLINES ARE LISTED INDIVIDUALLY IF DOT RECEIVED 5 OR MORE COMPLAINTS AGAINST THEM DURING THE REPORTING PERIOD. COMPLAINTS AGAINST U.S.AIRLINES ACCOUNTING FOR FEWER COMPLAINTS THAN THAT ARE INCLUDED UNDER 'OTHER U.S. AIRLINES.'

U.S. DEPARTMENT OF TRANSPORTATION
OFFICE OF CONSUMER AFFAIRS

AIR TRAVEL CONSUMER REPORT

COMPLAINTS AGAINST U.S. AIRLINES, BY INCIDENT DATE

JULY 1991

U.S. AIRLINES ALPHABETICAL	COMPS RECD IN JUL	INCI-DENTS IN JUL	PERCENT	INCI-DENTS IN JUN	PERCENT	INCI-DENTS IN ALL PRIOR MONTHS	PERCENT	UN-KNOWN INCI-DENT DATE	PERCENT
AMERICA WEST AIRLINES	26	3	11.54	6	23.08	15	57.69	2	7.69
AMERICAN AIRLINES	109	30	27.52	36	33.03	37	33.94	6	5.50
CONTINENTAL AIRLINES	50	12	24.00	23	46.00	12	24.00	3	6.00
DELTA AIR LINES	43	7	16.28	17	39.53	14	32.56	5	11.63
EASTERN AIR LINES	19	1	5.26	0	0.00	7	36.84	11	57.89
HAWAIIAN AIRLINES	13	1	7.69	8	61.54	4	30.77	0	0.00
MIDWAY AIRLINES	6	3	50.00	1	16.67	2	33.33	0	0.00
NORTHWEST AIRLINES	29	12	41.38	10	34.48	3	10.34	4	13.79
PAN AM EXPRESS	5	3	60.00	2	40.00	0	0.00	0	0.00
PAN AMERICAN WORLD AIRWAY	30	4	13.33	8	26.67	13	43.33	5	16.67
SOUTHWEST AIRLINES	9	4	44.44	0	0.00	5	55.56	0	0.00
TRANS WORLD AIRLINES	97	25	25.77	22	22.68	44	45.36	6	6.19
UNITED AIRLINES	114	33	28.95	38	33.33	30	26.32	13	11.40
USAIR	25	9	36.00	10	40.00	5	20.00	1	4.00
OTHER U.S. AIRLINES	41	21	51.22	12	29.27	6	14.63	2	4.88
	----	----	-----	----	-----	----	-----	----	-----
TOTALS	616	168	27.27	193	31.33	197	31.98	58	9.42
PRIOR YEAR'S TOTALS	542	174	32.10	147	27.12	202	37.27	19	3.51

AIRLINES ARE LISTED INDIVIDUALLY IF DOT RECEIVED 5 OR MORE COMPLAINTS AGAINST THEM DURING THE REPORTING PERIOD. COMPLAINTS AGAINST U.S. AIRLINES ACCOUNTING FOR FEWER COMPLAINTS THAN THAT ARE INCLUDED UNDER 'OTHER U.S. AIRLINES'.

U.S. DEPARTMENT OF TRANSPORTATION
OFFICE OF CONSUMER AFFAIRS

AIR TRAVEL CONSUMER REPORT

COMPANIES OTHER THAN U.S. AIRLINES
BY COMPLAINT CATEGORY

JULY 1991

	FLIGHT PROBLEMS	OVER-SALES	TICKETING/ BOARDING	FARES	REFUNDS	BAGGAGE	CUSTOMER SERVICE	SMOKING	ADVER-TISING	CREDIT	TOURS	OTHER	TOTAL
FOREIGN AIRLINES													
OTHER FOREIGN AIRLINES	6	7	7	4	16	27	2	2	0	0	0	2	73
TOTAL	6	7	7	4	16	27	2	2	0	0	0	2	73
CARGO COMPANIES													
OTHER CARGO COMPANIES	0	0	0	0	0	0	0	0	0	0	0	1	1
TOTAL	0	0	0	0	0	0	0	0	0	0	0	1	1
TRAVEL AGENTS													
OTHER TRAVEL AGENTS	0	0	3	0	2	0	0	0	0	0	0	0	5
TOTAL	0	0	3	0	2	0	0	0	0	0	0	0	5
TOUR OPERATORS													
OTHER TOUR OPERATORS	1	0	0	0	1	1	0	0	0	0	0	0	3
TOTAL	1	0	0	0	1	1	0	0	0	0	0	0	3
MISCELLANEOUS													
OTHER MISCELLANEOUS	4	0	5	1	2	2	0	0	0	0	2	5	21
TOTAL	4	0	5	1	2	2	0	0	0	0	2	5	21

COMPANIES ARE LISTED INDIVIDUALLY IF DOT RECEIVED 0 OR MORE COMPLAINTS AGAINST THEM DURING THE REPORTING PERIOD. COMPLAINTS AGAINST COMPANIES ACCOUNTING FOR FEWER COMPLAINTS THAN THAT ARE INCLUDED UNDER 'OTHER FOREIGN AIRLINES', 'OTHER CARGO COMPANIES', ETC.

AIR TRAVEL CONSUMER REPORT

U.S. DEPARTMENT OF TRANSPORTATION
OFFICE OF CONSUMER AFFAIRS

CONSUMER COMPLAINTS
SUMMARY

	JULY 1991				JULY 1990			
	COMPLAINTS	OPINIONS	COMPLIMENTS	INFO REQUESTS	COMPLAINTS	OPINIONS	COMPLIMENTS	INFO REQUESTS
U.S. AIRLINES	616	19	4	101	542	10	7	34
FOREIGN AIRLINES	73	1	0	19	82	0	1	9
CARGO COMPANIES	1	0	0	2	2	0	0	0
TRAVEL AGENTS	5	1	0	2	4	0	0	7
TOUR OPERATORS	3	0	0	3	11	0	0	3
MISCELLANEOUS	21	12	1	91	42	9	0	59
	----	----	----	----	----	----	----	----
INDUSTRY TOTALS	719	33	5	218	683	19	8	112

OFFICE OF CONSUMER AFFAIRS
U.S. DEPARTMENT OF TRANSPORTATION

JULY
AIR TRAVEL CONSUMER COMPLAINT REPORT
MAJOR/NATIONAL U.S. AIRLINES*

RANKINGS

JULY '91 RANK	U.S. AIRLINES	JULY 1991 COMPLAINTS	JULY 1991 PASSENGERS**	JULY 1991 COMPLAINTS PER 100,000 PASSENGERS	JULY 1990 COMPLAINTS	JULY 1990 PASSENGERS**	JULY 1990 COMPLAINTS PER 100,000 PASSENGERS
	MAJORS						
1	Southwest	9	2,226,867	0.40	8	2,053,835	0.39
2	USAir	25	4,771,659	0.52	39	5,201,074	0.75
3	Delta	43	6,662,584	0.65	33	5,867,123	0.56
4	Northwest	29	3,761,385	0.77	38	3,757,967	1.01
5	Continental	50	3,657,895	1.37	64	3,505,827	1.83
6	American	109	7,382,487	1.48	57	6,572,345	0.87
7	America West	26	1,626,155	1.60	18	1,344,617	1.34
8	United	114	5,989,856	1.90	68	5,473,511	1.24
9	Pan Am	30	1,246,373	2.41	45	1,761,826	2.55
10	TWA	97	1,959,280	4.95	107	2,399,147	4.46
	TOTAL MAJORS	532	39,284,541	1.35	477	37,937,272	1.26
	NATIONALS						
1	Westair	0	262,854	0.00	0	175,614	0.00
2	Air Wisconsin	0	235,240	0.00	0	207,727	0.00
3	Trump Shuttle	0	130,142	0.00	0	145,191	0.00
4	Midwest Express	0	64,379	0.00			N.A.
5	Markair	0	49,207	0.00	0	56,903	0.00
6	Aloha	1	470,099	0.21	1	418,954	0.24
7	Horizon	1	191,849	0.52	0	177,148	0.00
8	Alaska	4	615,569	0.65	1	554,829	0.18
9	Midway	6	437,446	1.37	2	647,104	0.31
10	American Trans Air	4	225,298	1.78	2	237,138	0.84
11	Hawaiian	13	419,943	3.10	6	474,004	1.27
12	Tower	4	62,273	6.42	0	53,141	0.00
	TOTAL NATIONALS	33	3,164,299	1.04	12	3,147,753	0.38
	GRAND TOTAL	565	42,448,840	1.33	489	41,085,025	1.19

* Airlines are grouped based on annual operating revenues. Airlines are classified as Majors if they exceed $1,000,000,000 operating revenue. Nationals are airlines with operating revenues from $100,000,000 through $1,000,000,000.

** The number of passengers on this page is from the same month as the complaints; e.g., January complaints are compared against January passengers.

COMPLAINT CATEGORIES

Flight Problems: Cancellations, delays, or any other deviations from schedule, whether planned or unplanned.

Oversales: All bumping problems, whether o[illegible] the airline [illegible]ed with DOT oversale regulations.

Ticketing and Boarding: Airline or travel a[illegible] mistakes in reservations and ticketing; problems in making reservations and obtaining tickets due to busy telephone lines or waiting [illegible] line, or delays in mailing tickets. Problems boarding the aircraft (except oversales). Complaints involving disabled air travelers.

Fares: Incorrect or incomplete information about fares, discount fare conditions and availability, overcharges, fare increases and level of fares in general.

Refunds: Problems in obtaining refunds for unused or lost tickets or fare adjustments.

Baggage: Claims for lost, damaged or delayed baggage, charges for excess baggage, carry-on problems, and difficulties with airline claim procedure.

Customer Service: Rude or unhelpful employees, inadequate meals or cabin service, treatment of delayed passengers.

Smoking: Inadequate segregation of smokers from non-smokers; failure of airline to enforce no-smoking rules; objections to the rule, would prefer change such as; (1) relaxation or elimination of regulations, or (2) banning of smoking on all flights.

Advertising: Advertising that is unfair, misleading or offensive to consumers.

Credit: Denial of credit, interest or late payment charges, incorrect billing, or incorrect credit reports on airline-issued credit.

Tours: Problems with scheduled or charter tour packages.

Other: Cargo problems, security, airport facilities, claims for bodily injury, frequent flyer, and other problems not classified above.

9142-20 A

CAB NEWS

CIVIL AERONAUTICS BOARD, WASHINGTON, D.C. 20428

Contact: Alan M. Pollock
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FOR RELEASE
Thursday
January 6, 1983
CAB 83-5

AIRLINE CONSUMER COMPLAINTS UP 3% IN OCTOBER

WASHINGTON, D.C. (January 6)--Consumer complaints to the Civil Aeronautics Board increased 3 percent in October 1982 over the same month the previous year, according to John Golden, Director of the Board's Office of Congressional, Community and Consumer Affairs.

For October 1982, 845 complaints were filed with the Board, compared with 822 in October 1981. For U.S. carriers, the increase was 2 percent, from 688 to 701.

For the first 10 months of 1982, consumer complaints dropped 23 percent for all categories, 21 percent for U.S. carriers.

For that same period, flight problems comprised 23.3 percent of complaints against U.S. airlines, followed by baggage problems (18.1 percent) and oversales (15.5). For foreign carriers, the largest categories of complaints were baggage (28.6 percent) and oversales (17.8).

NOTES TO REPORT

a/ This report is based on informal consumer complaints the Board has received by mail or telephone. We have not determined the validity of each complaint. The types of problems included in each category are:

Flight Problems: Cancellations, delays, or any other deviations from schedule, whether planned or unplanned.

Oversales: All bumping problems, whether or not the airline complied with CAB oversale regulations.

Reservations and Ticketing: Airline or agent mistakes in reservations and ticketing; problems in making reservations and obtaining tickets due to busy telephone lines or waiting in line, or delays in mailing tickets.

Fares: Incorrect or incomplete information about fares, discount fare conditions and availability, overcharges, fare increases and level of fares in general.

Refunds: Problems in obtaining refunds for unused or lost tickets.

Baggage: Lost, damaged or delayed baggage claims, charges for excess baggage, carry-on problems, and difficulties with airline claim procedure.

Customer Service: Rude or unhelpful employees, inadequate meals or cabin service, treatment of delayed passengers, and discriminatory treatment.

Special Passengers: Handicapped passengers, passengers on stretchers, children, elderly passengers, passengers requiring oxygen or other medical care.

Smoking: Inadequate segregation of smokers from non-smokers, failure of airline to enforce no-smoking rules, objections to the rules.

Advertising: Advertising that is unfair, misleading, or offensive to consumers.

Credit: Denial of credit, interest or late payment charges, incorrect billing, or incorrect credit reports.

Tours: Problems with scheduled or charter tour packages.

Other: Cargo problems, security, airport facilities, claims for bodily injury, lack of adequate service, and other problems not classified above.

b/ Airlines are listed on the October report if the Board received 5 or more complaints against them during the month. For the January through October report, airlines with at least 10 complaints are listed.

c/ All complaints about Allegheny Commuters are charged to USAir, and the number of passengers listed for USAir includes commuter boardings. These commuters are: Air Kentucky, Chautauqua Airlines, Crown Airways, Fischer Bros. Aviation, Henson Airlines, Pennsylvania Commuter Airlines, Pocono Airlines, Southern Jersey Airways and Suburban Airlines.

d/ The number of passengers flown is based on adjusted enplanement data on CAB Form 41 reports filed by certificated airlines. For the October report, the number of passengers flown are from August 1982 and 1981. For the January through October report, the number of passengers flown are from November and December 1980 and 1981 and August 1982 and 1981.

CIVIL AERONAUTICS BOARD CONSUMER COMPLAINT REPORT [a]
FOR THE MONTH OF OCTOBER 1982

U.S. AIRLINES [b]	FLIGHT PROBLEMS	OVER-SALES	RESERVATIONS AND TICKETING	FARES	REFUNDS	BAGGAGE	CUSTOMER SERVICE	SPECIAL PASSENGERS	SMOKING	ADVER-TISING	CREDIT	TOURS	OTHER	TOTAL
AIR FLORIDA	5	2	0	2	0	5	2	0	0	0	0	0	0	16
AMERICAN	3	2	3	2	1	4	3	0	1	0	1	0	1	21
ASPEN AIRWAYS	2	1	0	0	0	3	0	0	0	0	0	0	0	6
BRANIFF INT'L	0	0	0	0	5	0	0	0	0	0	0	0	1	6
CAPITOL AIR	8	7	6	1	3	10	4	0	1	0	0	0	4	44
CONTINENTAL	5	0	0	2	1	3	3	1	0	0	0	0	1	16
DELTA	7	1	4	8	1	2	3	0	0	1	0	0	1	28
EASTERN	6	0	2	4	3	7	1	1	1	0	1	1	1	28
METRO INTERNATIONAL	3	1	0	0	0	2	1	0	0	0	0	1	0	8
NEW YORK AIR	2	2	1	0	0	3	1	0	0	0	0	0	0	9
NORTHEASTERN INT'L.	4	1	0	0	14	2	1	0	0	0	0	0	0	22
NORTHWEST	17	2	5	1	4	2	5	0	0	0	0	0	0	36
OVERSEAS NATIONAL AIRWAYS	3	0	0	0	0	1	0	0	0	0	0	1	1	6
OZARK	1	1	0	0	0	1	1	1	0	0	0	0	0	5
PACIFIC EAST AIR	4	2	0	1	4	0	0	0	0	0	0	0	0	11
PAN AMERICAN	10	4	2	4	4	11	4	4	2	0	1	1	3	50
PEOPLE EXPRESS AIRLINES	2	2	2	2	1	2	0	0	0	0	0	0	0	11
PIEDMONT	3	3	0	1	1	2	3	0	1	0	0	0	1	15
PSA	1	2	1	0	1	1	1	0	0	0	0	0	0	7
REPUBLIC	3	1	1	3	3	2	2	0	0	0	0	0	2	17
SOUTHWEST	1	1	2	0	0	0	1	0	0	0	0	0	1	6
TEXAS INT'L	2	1	0	0	4	4	1	0	0	0	0	0	0	12
TWA	18	8	3	5	2	18	13	0	7	0	1	1	2	78
UNITED	7	14	1	6	4	16	9	0	2	0	1	0	2	62
USAIR [c]	5	8	2	3	0	3	3	0	0	0	0	0	2	26
WESTERN	4	2	1	2	3	3	1	0	0	0	0	0	0	16
WORLD	8	2	1	2	1	2	3	1	0	0	0	0	0	20
OTHER U.S. AIRLINES	25	22	5	6	12	27	13	1	2	0	0	1	5	1[illegible]
OCTOBER 1982 COMPLAINTS	159	92	42	55	72	136	79	9	17	1	5	6	28	701
** PERCENTAGES **	22.7	13.1	6.0	7.9	10.3	19.4	11.3	1.3	2.4	.1	.7	.9	4.0	100.0
OCTOBER 1981 COMPLAINTS	166	99	36	63	55	148	69	3	14	10	6	0	19	688
** PERCENTAGES **	24.1	14.4	5.2	9.2	8.0	21.5	10.0	.4	2.0	1.5	.9	.0	2.8	100.0

CIVIL AERONAUTICS BOARD CONSUMER COMPLAINT REPORT
FOR THE MONTH OF OCTOBER 1982

U.S. AIRLINES............	OCTOBER 1982 TOTAL COMPLAINTS	OCTOBER 1982 PASSENGERS FLOWN (100,000)a/	OCTOBER 1982 COMPLAINTS PER 100,000 PASSENGERS	OCTOBER 1981 TOTAL COMPLAINTS	OCTOBER 1981 PASSENGERS FLOWN (100,000)a/	OCTOBER 1981 COMPLAINTS PER 100,000 PASSENGERS
AIR FLORIDA	16	2.82	5.67	29	3.06	9.48
AMERICAN	21	25.25	.83	50	23.50	2.13
ARROW AIRWAYS	6					
BRANIFF INT'L	6			24	8.29	2.90
CAPITOL AIR	44	2.23	19.73	45	1.51	29.80
CONTINENTAL	16	9.55	1.87	11	8.46	1.30
DELTA	26	27.39	1.02	20	29.41	.68
EASTERN	28	30.98	.90	40	29.44	1.36
METRO INTERNATIONAL	3			7		
NEW YORK AIR	9	1.42	6.34	16	1.36	11.76
NORTHEASTERN INT'L.	22	.13	169.23			
NORTHWEST	36	12.49	2.88	28	10.79	2.59
OVERSEAS NATIONAL AIRWAYS	6					
OZARK	5	4.03	1.24	5	3.12	1.60
PACIFIC EAST AIR	11					
PAN AMERICAN	50	13.06	3.82	48	13.24	3.63
PEOPLE EXPRESS AIRLINES	11	2.67	4.12	16	1.31	12.21
PIEDMONT	15	8.33	1.80	9	6.49	1.39
PSA	7	6.01	.67	2	5.74	.35
REPUBLIC	17	16.64	1.02	25	14.23	1.76
SOUTHWEST	6	8.77	.68	1	6.70	.15
TEXAS INT'L	12	4.35	2.76	14	3.34	4.19
TWA	78	17.89	4.36	85	16.07	5.29
UNITED	62	32.50	1.91	39	27.15	1.44
USAIR✓	26	15.16	1.72	25	11.83	2.11
WESTERN	16	10.06	1.59	9	9.24	.97
WORLD	20	1.66	12.05	29	2.28	12.72
OTHER U.S. AIRLINES	119	25.29	4.71	111	23.65	4.69

CIVIL AERONAUTICS BOARD CONSUMER COMPLAINT REPORT
FOR THE MONTH OF OCTOBER 1982

FOREIGN AIRLINES........	FLIGHT PROBLEMS	OVER-SALES	RESERVATIONS AND TICKETING	FARES	REFUNDS	BAGGAGE	CUSTOMER SERVICE	SPECIAL PASSENGERS	SMOKING	ADVER-TISING	CREDIT	TOURS	OTHER	TOTAL
BRITISH AIRWAYS	0	1	0	1	0	3	1	0	0	0	0	0	0	6
LUFTHANSA	0	1	0	0	1	0	0	0	2	0	0	0	1	5
SABENA	2	0	1	0	1	0	1	0	1	0	0	0	0	6
OTHER FOREIGN AIRLINES	10	18	3	3	10	20	7	0	2	0	0	2	2	77
OCTOBER 1982 COMPLAINTS	12	20	4	4	12	23	9	0	5	0	0	2	3	94
** PERCENTAGES **	12.8	21.3	4.3	4.3	12.8	24.5	9.6	.0	5.3	.0	.0	2.1	3.2	100.0
OCTOBER 1981 COMPLAINTS	11	12	5	3	11	33	9	0	2	0	0	1	10	97
** PERCENTAGES **	11.3	12.4	5.2	3.1	11.3	34.0	9.3	.0	2.1	.0	.0	1.0	10.3	100.0

COMPLAINTS BY INDUSTRY GROUP	FLIGHT PROBLEMS	OVER-SALES	RESERVATIONS AND TICKETING	FARES	REFUNDS	BAGGAGE	CUSTOMER SERVICE	SPECIAL PASSENGERS	SMOKING	ADVER-TISING	CREDIT	TOURS	OTHER	TOTAL
U.S. AIRLINES............														
OCTOBER 1982 COMPLAINTS	159	92	42	55	72	136	79	9	17	1	5	6	28	701
OCTOBER 1981 COMPLAINTS	166	99	36	63	55	148	69	3	14	10	6	0	19	688
FOREIGN AIRLINES........														
OCTOBER 1982 COMPLAINTS	12	20	4	4	12	23	9	0	5	0	0	2	3	94
OCTOBER 1981 COMPLAINTS	11	12	5	3	11	33	9	0	2	0	0	1	10	97
CARGO/FREIGHT FORWARDERS														
OCTOBER 1982 COMPLAINTS	0	0	0	0	0	0	0	0	0	0	0	0	4	4
OCTOBER 1981 COMPLAINTS	0	0	0	0	0	0	0	0	0	0	0	0	10	10
TRAVEL AGENTS...........														
OCTOBER 1982 COMPLAINTS	0	0	2	2	4	0	0	0	0	0	0	1	0	9
OCTOBER 1981 COMPLAINTS	0	0	1	0	5	0	0	0	0	0	0	2	0	8
TOUR OPERATORS..........														
OCTOBER 1982 COMPLAINTS	0	2	0	1	3	0	1	0	0	1	0	28	0	36
OCTOBER 1981 COMPLAINTS	0	1	0	1	1	0	0	0	1	0	0	14	0	18
OTHER CARRIERS..........														
OCTOBER 1982 COMPLAINTS	0	0	0	0	0	0	0	0	0	0	0	0	1	1
OCTOBER 1981 COMPLAINTS	0	1	0	0	0	0	0	0	0	0	0	0	0	1
TOTAL COMPLAINTS........														
OCTOBER 1982 COMPLAINTS	171	114	48	62	91	159	89	9	22	2	5	37	36	845
** PERCENTAGES **	20.2	13.5	5.7	7.3	10.8	18.8	10.5	1.1	2.6	.2	.6	4.4	4.3	100.0
OCTOBER 1981 COMPLAINTS	177	113	42	67	72	181	78	3	17	10	6	17	39	822
** PERCENTAGES **	21.5	13.7	5.1	8.2	8.8	22.0	9.5	.4	2.1	1.2	.7	2.1	4.7	100.0

CIVIL AERONAUTICS BOARD CONSUMER COMPLAINT REPORT a/
JANUARY 1982 THROUGH OCTOBER 1982

U.S. AIRLINES b/	FLIGHT PROBLEMS	OVER-SALES	RESERVATIONS AND TICKETING	FARES	REFUNDS	BAGGAGE	CUSTOMER SERVICE	SPECIAL PASSENGERS	SMOKING	ADVER-TISING	CREDIT	TOURS	OTHER	TOTAL
AERO VIRGIN ISLANDS	2	1	0	0	1	17	3	0	0	0	0	0	0	24
AIR CALIFORNIA	13	6	1	2	1	2	10	1	1	1	0	0	0	38
AIR FLORIDA	47	39	19	15	25	39	21	1	4	2	3	0	4	218
AIR ILLINOIS	0	4	0	1	2	1	1	0	1	0	0	0	0	10
AIR NEW ENGLAND	3	2	0	1	5	0	0	0	0	0	1	0	0	12
AIR WISCONSIN	5	2	0	0	0	3	2	0	0	0	0	0	1	13
ALOHA AIRLINES	0	4	2	1	2	8	1	0	0	0	0	0	1	19
ALTAIR	11	8	2	3	11	9	4	1	1	0	0	0	0	50
AMERICAN	104	72	55	43	29	100	78	8	18	12	14	2	21	556
ARISTA INTERNATIONAL	2	1	0	0	0	1	5	0	0	0	0	1	0	10
ARROW AIRWAYS	8	3	0	0	0	13	0	0	1	0	0	0	1	26
ASPEN	3	3	1	1	2	5	1	0	1	0	0	0	0	17
BAR HARBOR AIRLINES	5	3	2	1	2	3	2	0	0	0	0	0	3	21
BRANIFF INT'L	15	19	6	4	109	50	9	1	3	1	2	0	11	230
BRITT AIRWAYS	4	4	0	0	2	6	1	1	0	0	0	0	0	18
CAPITOL AIR	114	117	18	10	29	78	48	2	5	6	1	0	18	446
CASCADE	4	2	1	2	1	1	0	0	0	0	0	0	0	11
COMAIR	1	1	1	0	0	3	1	0	0	0	0	0	3	10
COMMAND AIRWAYS	3	2	1	0	0	2	2	1	0	0	0	0	0	11
CONTINENTAL	36	21	12	16	13	35	25	2	4	3	3	0	6	176
CROWNAIR	2	1	0	1	1	8	0	0	0	0	0	0	1	14
DELTA	58	22	19	30	13	27	32	4	12	8	4	0	5	234
EASTERN	128	24	32	42	44	88	79	7	10	5	12	2	16	489
EMPIRE	15	12	0	3	0	2	2	0	0	0	0	0	2	36
FRONTIER	16	5	2	8	7	15	6	0	1	0	1	0	7	68
GLOBAL INTERNATIONAL	8	1	0	2	0	3	7	0	2	0	0	1	5	29
GOLDEN WEST AIRLINES	16	5	1	1	4	4	3	0	0	0	0	1	0	35
HAWAIIAN	7	4	2	1	5	8	2	0	0	0	0	0	2	31
IMPERIAL AIRLINES	4	3	0	0	0	4	3	1	0	0	0	0	1	16
JET AMERICA AIRLINES	1	1	1	3	0	2	2	0	0	1	0	0	1	12
METRO AIRLINES	11	3	2	1	0	2	1	0	0	0	0	0	0	20
METRO INTERNATIONAL	10	1	0	0	0	5	3	0	0	0	0	2	1	22
MID PACIFIC AIRLINES	1	2	1	0	0	11	1	1	0	1	0	0	1	19
MIDWAY	11	7	1	1	1	11	3	1	1	0	0	0	0	37
MISSISSIPPI VALLEY	0	5	0	1	2	3	0	0	0	0	0	0	0	11
NEW YORK AIR	32	13	10	5	9	25	11	3	0	0	1	0	2	111
NORTHEASTERN INT'L.	37	45	8	0	53	3	2	0	2	2	3	0	0	155
NORTHWEST	30	22	11	15	21	25	44	3	4	4	2	0	4	235
OCEANAIR LINE	0	1	0	0	0	9	0	0	0	0	0	0	0	10
OVERSEAS NATIONAL AIRWAYS	6	0	0	0	0	1	1	0	1	0	0	3	4	16
OZARK	13	4	2	4	4	9	6	1	2	0	0	1	1	47
PACIFIC EAST AIR	8	10	2	1	8	2	2	0	0	0	0	0	0	33
PAN AMERICAN	95	94	29	28	55	120	61	8	20	4	4	1	24	537
PEOPLE EXPRESS AIRLINES	47	32	14	24	4	16	14	2	0	1	0	0	2	156
PIEDMONT	23	21	3	5	9	10	7	2	1	0	0	0	4	85
PILGRIM AIRLINES	7	3	1	0	0	1	2	0	1	0	0	0	0	15
PIONEER	4	2	0	0	2	3	1	0	0	0	0	0	0	12
PRECISION	7	5	0	0	3	0	1	0	0	0	1	0	0	17
PRO AIR SERVICES	5	1	0	1	1	1	1	0	0	0	0	0	1	11
PSA	17	4	2	2	2	9	4	1	1	1	0	0	2	50

CIVIL AERONAUTICS BOARD CONSUMER COMPLAINT REPORT [a]
JANUARY 1982 THROUGH OCTOBER 1982

U.S. AIRLINES [b]	FLIGHT PROBLEMS	OVER-SALES	RESERVATIONS AND TICKETING	FARES	REFUNDS	BAGGAGE	CUSTOMER SERVICE	SPECIAL PASSENGERS	SMOKING	ADVER-TISING	CREDIT	TOURS	OTHER	TOTAL
PRIMAIR	1	3	1	0	0	18	1	0	0	0	0	0	1	25
REPUBLIC	82	65	11	25	24	38	41	3	4	12	4	0	18	327
RIO AIRWAYS	6	0	1	0	3	4	3	0	0	0	0	0	0	17
ROCKY MOUNTAIN	3	2	1	0	1	3	2	1	0	0	0	0	0	13
ROYALE	5	2	0	0	0	1	6	0	0	0	0	0	0	14
SIMMONS AIRLINES	3	2	1	0	0	4	0	0	0	0	0	0	0	10
SOUTH PACIFIC ISLAND	1	8	2	0	2	13	5	0	0	0	0	0	3	34
SOUTHWEST	12	13	6	1	4	9	7	1	2	0	1	0	3	59
SUN AIRE	3	9	1	0	0	9	2	1	0	0	0	0	1	26
TEXAS INT'L	26	32	8	10	17	18	16	2	5	1	0	0	4	139
TRANSAMERICA	6	1	1	1	1	2	3	0	1	0	0	3	0	19
TWA	179	109	40	53	51	163	130	12	39	8	14	5	23	826
UNITED	146	84	28	48	37	110	76	9	27	4	7	0	32	608
USAIR [c]	91	46	8	18	7	58	31	8	7	3	1	0	6	284
WESTERN COMMUTER	11	13	2	0	2	10	6	1	1	1	0	0	2	49
WESTERN	20	20	13	15	27	24	18	3	4	12	5	0	7	168
WIEN AIR ALASKA	3	2	1	1	1	3	1	0	1	0	0	0	1	14
WINGS WEST	6	5	0	1	0	1	2	0	0	0	0	0	1	16
WORLD	42	29	8	10	21	27	19	3	2	1	0	0	2	164
OTHER U.S. AIRLINES	74	69	14	9	37	60	17	2	1	4	0	3	21	311
CURRENT PERIOD TOTALS	1773	1175	411	471	717	1378	901	98	191	98	84	25	283	7602
** PERCENTAGES **	23.3	15.5	5.4	6.2	9.4	18.1	11.9	1.3	2.5	1.3	1.1	.3	3.7	100.0
SAME PERIOD PRIOR YEAR	2344	1137	521	576	725	2095	1178	113	264	95	94	30	401	9593
** PERCENTAGES **	24.4	11.9	5.4	6.0	7.6	21.8	12.3	1.2	3.0	1.0	1.0	.3	4.2	100.0

U.S. AIRLINES...........	CURRENT PERIOD TOTAL COMPLAINTS	CURRENT PERIOD PASSENGERS FLOWN (100,000)d/	CURRENT PERIOD COMPLAINTS PER 100,000 PASSENGERS	SAME PERIOD PRIOR YEAR TOTAL COMPLAINTS	SAME PERIOD PRIOR YEAR PASSENGERS FLOWN (100,000)d/	SAME PERIOD PRIOR YEAR COMPLAINTS PER 100,000 PASSENGERS
AERO VIRGIN ISLANDS	24			25		
AIR CALIFORNIA	38	29.62	1.28	64	28.75	2.23
AIR FLORIDA	218	25.24	8.64	358	26.34	13.59
AIR ILLINOIS	10			7		
AIR NEW ENGLAND	12			32		
AIR WISCONSIN	13	6.11	2.13	29	5.70	5.09
ALOHA AIRLINES	19	21.56	.88	15	10.97	1.37
ALTAIR	50	4.38	11.42	34	2.76	12.32
AMERICAN	556	226.55	2.45	632	205.27	3.08
ARISTA INTERNATIONAL	10					
ARROW AIRWAYS	26					
ASPEN	17	2.78	6.12	24	2.38	10.08
BAR HARBOR AIRLINES	21			17		
BRANIFF INT'L	230	56.91	4.04	418	90.54	4.62
BRITT AIRWAYS	18			33	3.20	10.31
CAPITOL AIR	446	15.04	29.65	304	8.31	36.58
CASCADE	11	2.34	4.70	6	2.02	2.97
COMAIR	10			13		
COMMAND AIRWAYS	11			6		
CONTINENTAL	176	77.20	2.28	197	67.15	2.93
CROWNAIR	14			4		
DELTA	234	283.72	.82	277	300.33	.92
EASTERN	489	295.26	1.66	810	307.14	2.64
EMPIRE	36	4.42	8.14	27	2.89	9.34
FRONTIER	68	50.74	1.34	98	52.52	1.67
GLOBAL INTERNATIONAL	29			2		
GOLDEN WEST AIRLINES	35	5.09	6.88	36	5.40	6.67
HAWAIIAN	31	27.31	1.14	33	25.31	1.30
IMPERIAL AIRLINES	16	1.87	8.56	21	1.08	19.44
JET AMERICA AIRLINES	12	1.32	9.09			
METRO AIRLINES	20			6		
METRO INTERNATIONAL	22			23		
MID PACIFIC AIRLINES	19			3		
MIDWAY	37	9.85	3.75	21	3.96	5.30
MISSISSIPPI VALLEY	11	3.91	2.81	23	2.62	8.78
NEW YORK AIR	111	15.02	7.39	127	8.91	14.25
NORTHEASTERN INT'L.	155	.54	287.04			
NORTHWEST	235	91.66	2.56	266	95.51	2.79
OCEANAIR LINE	10			23		
OVERSEAS NATIONAL AIRWAYS	16					
OZARK	47	36.58	1.28	73	36.34	2.01
PACIFIC EAST AIR	33					
PAN AMERICAN	537	109.72	4.89	1098	116.70	9.41
PEOPLE EXPRESS AIRLINES	156	20.24	7.71	51	3.70	13.78
PIEDMONT	85	68.13	1.25	80	56.60	1.41
PILGRIM AIRLINES	15			27		
PIONEER	12			10		
PRECISION	17			9		
PRO AIR SERVICES	11			1		
PSA	50	56.93	.88	103	45.38	2.27

CIVIL AERONAUTICS BOARD CONSUMER COMPLAINT REPORT
JANUARY 1982 THROUGH OCTOBER 1982

	CURRENT PERIOD			SAME PERIOD PRIOR YEAR		
U.S. AIRLINES............	TOTAL COMPLAINTS	PASSENGERS FLOWN (100,000)d/	COMPLAINTS PER 100,000 PASSENGERS	TOTAL COMPLAINTS	PASSENGERS FLOWN (100,000)d/	COMPLAINTS PER 100,000 PASSENGERS
PRIMAIR	25			80		
REPUBLIC	327	153.78	2.13	391	132.98	2.94
RIO AIRWAYS	17			16		
ROCKY MOUNTAIN	13	3.08	4.22	23	.48	47.92
ROYALE	14			6		
SIMMONS AIRLINES	10					
SOUTH PACIFIC ISLAND	34	.20	170.00	3	.21	14.29
SOUTHWEST	59	70.77	.83	55	64.28	.86
SUN AIRE	26			7		
TEXAS INT'L	139	36.61	3.80	225	34.03	6.61
TRANSAMERICA	19	4.29	4.43	43	6.88	6.25
TWA	826	146.62	5.63	1060	152.69	6.94
UNITED	608	271.56	2.24	586	246.91	2.37
USAIRc/	284	139.41	2.05	413	134.97	3.05
WESTAIR COMMUTER	49	2.80	17.50	13		
WESTERN	168	80.15	2.10	160	79.11	2.02
WIEN AIR ALASKA	14	8.46	1.65	10	7.52	1.33
WINGS WEST	16			3		
WORLD	164	14.33	11.44	400	16.61	24.08
OTHER U.S. AIRLINES	311	31.95	9.73	633	44.73	14.15

CIVIL AERONAUTICS BOARD CONSUMER COMPLAINT REPORT
JANUARY 1982 THROUGH OCTOBER 1982

FOREIGN AIRLINES........	FLIGHT PROBLEMS	OVER-SALES	RESERVATIONS AND TICKETING	FARES	REFUNDS	BAGGAGE	CUSTOMER SERVICE	SPECIAL PASSENGERS	SMOKING	ADVERTISING	CREDIT	TOURS	OTHER	TOTAL
AER LINGUS	3	3	0	1	2	2	1	1	0	0	0	1	0	14
AEROMEXICO	10	14	3	0	3	17	9	0	1	0	0	0	4	61
AIR CANADA	1	0	0	0	7	2	3	0	2	0	0	0	0	15
AIR FRANCE	8	3	0	1	2	11	5	0	2	0	0	0	4	36
AIR INDIA	2	9	1	2	2	6	3	0	0	0	0	0	0	25
AIR JAMAICA	2	8	1	0	4	3	1	0	0	0	0	0	2	21
ALITALIA AIRLINES	4	7	2	3	6	10	3	0	1	0	0	0	1	37
ALIA JORDANIAN AIRLINES	0	1	0	0	1	11	0	0	1	0	0	0	1	15
AVIANCA	3	6	0	1	3	0	1	1	0	0	0	0	2	17
BAHAMASAIR	4	1	0	1	1	7	1	0	0	0	0	0	0	15
BRITISH AIRWAYS	12	13	7	4	2	18	9	0	3	1	0	0	1	70
BRITISH CALEDONIAN AIRWAY	1	1	3	2	0	0	3	0	2	0	0	0	0	12
BWIA	5	1	0	0	0	5	0	0	0	0	0	0	0	11
DOMINICANA DE AVIACION	1	5	0	0	0	5	1	0	0	0	0	0	1	13
FAUCETT, S.A.	0	1	0	1	4	6	0	0	0	0	0	0	1	13
IBERIA AIRLINES	2	12	0	2	5	11	3	1	2	0	0	0	1	39
KOREAN AIRLINES	1	2	1	1	2	7	3	0	0	0	0	1	3	21
KUWAIT AIRWAYS	1	1	3	0	0	6	2	0	0	0	0	0	0	13
KLM	3	6	7	3	5	9	3	0	2	0	0	0	3	41
LAKER AIRWAYS	0	0	1	0	22	0	0	0	0	0	0	0	2	25
LUFTHANSA	5	2	1	4	4	9	3	0	5	0	1	0	2	36
LACSA	0	2	1	0	2	7	0	0	0	0	0	0	0	12
MEXICANA	7	22	2	0	4	25	8	3	0	0	1	1	3	76
OLYMPIC AIRWAYS	4	3	3	2	1	5	4	0	0	0	0	0	0	22
PAKISTAN INTERNATIONAL	0	2	0	0	4	6	0	0	0	0	0	0	1	13
ROYAL AIR MAROC	1	4	0	1	0	3	1	0	1	0	0	0	0	11
SABENA	3	0	2	0	2	6	1	0	3	0	0	0	0	17
SINGAPORE AIRLINES	0	3	0	0	3	3	0	0	0	0	0	0	1	10
SWISSAIR	1	2	0	2	0	1	2	0	0	0	0	0	3	11
SAS	2	4	2	2	0	1	0	0	2	0	0	0	0	13
VIASA	0	2	0	0	0	6	1	0	0	0	0	0	2	11
OTHER FOREIGN AIRLINES	28	27	8	7	25	60	11	1	3	1	1	4	14	190
CURRENT PERIOD TOTALS	114	167	48	40	116	268	82	7	30	2	3	7	52	936
** PERCENTAGES **	12.2	17.8	5.1	4.3	12.4	28.6	8.8	.7	3.2	.2	.3	.7	5.6	100.0
SAME PERIOD PRIOR YEAR	231	226	70	81	143	444	141	2	34	11	0	6	81	1470
** PERCENTAGES **	15.7	15.4	4.8	5.5	9.7	30.2	9.6	.1	2.3	.7	.0	.4	5.5	100.0

COMPLAINTS BY INDUSTRY GROUP	FLIGHT PROBLEMS	OVER-SALES	RESERVATIONS AND TICKETING	FARES	REFUNDS	BAGGAGE	CUSTOMER SERVICE	SPECIAL PASSENGERS	SMOKING	ADVER-TISING	CREDIT	TOURS	OTHER	TOTAL
U.S. AIRLINES..........														
CURRENT PERIOD TOTALS	1773	1175	411	471	717	1378	901	98	191	98	84	25	280	7602
SAME PERIOD PRIOR YEAR	2344	1137	521	576	725	2095	1176	113	284	95	94	30	401	9593
FOREIGN AIRLINES........														
CURRENT PERIOD TOTALS	114	167	48	40	116	268	82	7	30	2	3	7	52	936
SAME PERIOD PRIOR YEAR	231	226	70	81	143	444	141	2	34	11	0	6	81	1470
CARGO/FREIGHT FORWARDERS														
CURRENT PERIOD TOTALS	0	0	0	1	0	1	0	0	0	0	0	0	34	36
SAME PERIOD PRIOR YEAR	0	0	0	0	1	0	0	0	0	0	0	0	91	92
TRAVEL AGENTS..........														
CURRENT PERIOD TOTALS	3	3	22	14	27	1	3	0	0	0	1	27	1	102
SAME PERIOD PRIOR YEAR	4	0	42	13	38	3	2	0	0	2	3	19	3	129
TOUR OPERATORS..........														
CURRENT PERIOD TOTALS	6	16	11	5	16	9	8	0	0	7	1	221	5	305
SAME PERIOD PRIOR YEAR	9	6	15	5	28	9	4	0	1	6	2	217	2	304
OTHER CARRIERS..........														
CURRENT PERIOD TOTALS	0	2	0	1	0	3	1	2	1	0	0	0	5	15
SAME PERIOD PRIOR YEAR	6	4	2	16	2	11	5	2	38	2	1	2	48	139
TOTAL COMPLAINTS........														
CURRENT PERIOD TOTALS	1896	1363	492	532	876	1660	995	107	222	107	89	280	377	8996
** PERCENTAGES **	21.1	15.2	5.5	5.9	9.7	18.5	11.1	1.2	2.5	1.2	1.0	3.1	4.2	100.0
SAME PERIOD PRIOR YEAR	2594	1373	650	691	937	2562	1330	117	357	116	100	274	626	11727
** PERCENTAGES **	22.1	11.7	5.5	5.9	8.0	21.8	11.3	1.0	3.0	1.0	.9	2.3	5.3	100.0

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CAB NEWS

CIVIL AERONAUTICS BOARD, WASHINGTON, D.C. 20428

Contact: Alan M. Pollock
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FOR RELEASE
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CAB 83-13

AIRLINE CONSUMER COMPLAINTS DOWN 23% IN 1982

WASHINGTON, D.C. (January 18)--Consumer complaints to the Civil Aeronautics Board dropped 23 percent in 1982, according to John Golden, Director of the Board's Office of Congressional, Community and Consumer Affairs.

In 1982, 10,151 complaints were filed with the Board, compared with 13,189 in 1981. For U.S. carriers, the decrease was 21 percent, from 10,826 to 8,566.

The November and December monthly figures also were released today, showing drops of 13 percent (683 to 596) and 25 percent (745 to 558), respectively.

For U.S. airlines, flight problems comprised 23.5 percent of complaints in 1982, followed by baggage problems (17.8 percent) and oversales (15.1). For foreign carriers, the largest categories of complaints were baggage (27.7 percent) and oversales (18.1).

NOTES TO REPORT

a/ This report is based on informal consumer complaints the Board has received by mail or telephone. We have not determined the validity of each complaint. The types of problems included in each category are:

Flight Problems: Cancellations, delays, or any other deviations from schedule, whether planned or unplanned.

Oversales: All bumping problems, whether or not the airline complied with CAB oversale regulations.

Reservations and Ticketing: Airline or agent mistakes in reservations and ticketing; problems in making reservations and obtaining tickets due to busy telephone lines or waiting in line, or delays in mailing tickets.

Fares: Incorrect or incomplete information about fares, discount fare conditions and availability, overcharges, fare increases and level of fares in general.

Refunds: Problems in obtaining refunds for unused or lost tickets.

Baggage: Lost, damaged or delayed baggage claims, charges for excess baggage, carry-on problems, and difficulties with airline claim procedure.

Customer Service: Rude or unhelpful employees, inadequate meals or cabin service, treatment of delayed passengers, and discriminatory treatment.

Special Passengers: Handicapped passengers, passengers on stretchers, children, elderly passengers, passengers requiring oxygen or other medical care.

Smoking: Inadequate segregation of smokers from non-smokers, failure of airline to enforce no-smoking rules, objections to the rules.

Advertising: Advertising that is unfair, misleading, or offensive to consumers.

Credit: Denial of credit, interest or late payment charges, incorrect billing, or incorrect credit reports.

Tours: Problems with scheduled or charter tour packages.

Other: Cargo problems, security, airport facilities, claims for bodily injury, lack of adequate service, and other problems not classified above.

b/ Airlines are listed on the November and December reports if the Board received 5 or more complaints against them during those months. For the January through November and the January through December reports, airlines with at least 10 complaints are listed.

c/ All complaints about Allegheny Commuters are charged to USAir, and the number of passengers listed for USAir includes commuter boardings. These commuters are: Air Kentucky, Chautauqua Airlines, Crown Airways, Fischer Bros. Aviation, Henson Airlines, Pennsylvania Commuter Airlines, Pocono Airlines, Southern Jersey Airways and Suburban Airlines.

d/ The number of passengers flown is based on adjusted enplanement data on CAB Form 41 reports filed by certificated airlines. For the November report, the number of passengers flown are from September 1982 and 1981. For the December report, the number of passengers flown are from October 1982 and 1981. For the January through November and January through December reports, the number of passengers flown are from November and December 1980 and 1981 and January through September and October 1982 and 1981.

CIVIL AERONAUTICS BOARD CONSUMER COMPLAINT REPORT [a/]
FOR THE MONTH OF NOVEMBER 1982

U.S. AIRLINES [b/]	FLIGHT PROBLEMS	OVER-SALES	RESERVATIONS AND TICKETING	FARES	REFUNDS	BAGGAGE	CUSTOMER SERVICE	SPECIAL PASSENGERS	SMOKING	ADVER-TISING	CREDIT	TOURS	OTHER	TOTAL
AIR FLORIDA	1	1	1	0	1	5	1	0	0	0	0	0	0	10
ALTAIR	6	0	0	1	11	3	0	0	0	0	0	0	0	21
AMERICAN	4	2	3	4	3	4	1	0	1	3	1	0	4	30
BRANIFF INT'L	0	0	0	0	5	0	0	0	0	0	0	0	1	6
CAPITOL AIR	6	3	2	2	2	4	2	0	0	0	0	0	0	21
CONTINENTAL	3	3	0	1	1	0	1	0	0	1	0	0	1	11
DELTA	4	0	1	4	4	4	0	0	0	2	0	0	0	19
EASTERN	6	2	2	4	5	5	2	0	2	1	1	0	0	30
FRONTIER	2	0	0	0	1	0	0	0	0	0	0	0	2	5
GLOBAL INTERNATIONAL	2	0	0	0	0	1	0	0	1	0	0	1	0	5
NEW YORK AIR	3	0	0	0	1	0	1	0	0	0	0	0	0	5
NORTHEASTERN INT'L.	3	1	2	0	9	0	0	0	0	0	0	0	0	15
NORTHWEST	2	2	3	1	1	2	1	0	2	0	0	0	0	14
PACIFIC EAST AIR	1	1	1	1	6	0	0	0	0	0	0	0	0	10
PAN AMERICAN	6	3	1	1	5	7	1	0	0	2	0	0	2	28
PEOPLE EXPRESS AIRLINES	4	1	2	0	1	0	1	1	0	0	0	0	1	11
PIEDMONT	0	2	1	1	1	3	0	0	0	0	1	0	0	9
REPUBLIC	8	6	2	1	2	1	0	0	0	0	0	0	1	21
SOUTHWEST	0	1	2	0	0	2	0	0	0	0	0	0	0	5
TEXAS INT'L	0	2	2	0	1	1	0	0	0	0	0	0	0	6
TRANSAMERICA	2	2	0	0	0	0	2	0	0	0	0	0	0	6
TWA	9	5	2	1	6	8	3	0	4	1	1	0	1	41
UNITED	11	3	0	2	1	9	3	1	2	0	1	0	2	35
USAIR [c/]	8	2	0	3	3	6	1	0	1	0	0	0	2	26
WESTAIR COMMUTER	0	3	0	0	1	1	0	0	0	0	0	0	0	5
WESTERN	1	0	1	3	0	3	2	0	0	0	0	0	0	10
OTHER U.S. AIRLINES	16	9	2	4	9	16	1	0	1	1	0	2	9	68
NOVEMBER 1982 COMPLAINTS	108	53	30	34	80	85	23	2	14	11	5	3	25	473
** PERCENTAGES **	22.8	11.2	6.3	7.2	16.9	18.0	4.9	.4	3.0	2.3	1.1	.6	5.3	100.0
NOVEMBER 1981 COMPLAINTS	120	70	40	39	55	130	72	7	11	10	5	5	20	584
** PERCENTAGES **	20.5	12.0	6.9	6.7	9.4	22.3	12.3	1.2	1.9	1.7	.9	.9	3.4	100.0

CIVIL AERONAUTICS BOARD CONSUMER COMPLAINT REPORT
FOR THE MONTH OF NOVEMBER 1982

U.S. AIRLINES...........	NOVEMBER 1982 TOTAL COMPLAINTS	NOVEMBER 1982 PASSENGERS FLOWN (100,000)a/	NOVEMBER 1982 COMPLAINTS PER 100,000 PASSENGERS	NOVEMBER 1981 TOTAL COMPLAINTS	NOVEMBER 1981 PASSENGERS FLOWN (100,000)a/	NOVEMBER 1981 COMPLAINTS PER 100,000 PASSENGERS
AIR FLORIDA	10	2.02	4.95	22	2.43	9.05
ALTAIR	21	.51	41.18	1	.30	3.33
AMERICAN	30	20.55	1.46	47	19.93	2.36
BRANIFF INT'L	6			23	7.23	3.18
CAPITOL AIR	21	1.30	16.15	23	1.26	18.25
CONTINENTAL	11	6.03	1.81	15	6.92	2.17
DELTA	19	22.93	.83	12	25.46	.47
EASTERN	30	25.63	1.17	36	25.35	1.42
FRONTIER	5	4.49	1.11	11	4.97	2.21
GLOBAL INTERNATIONAL	5					
NEW YORK AIR	5	1.30	3.85	12	1.58	7.59
NORTHEASTERN INT'L.	15	.10	150.00			
NORTHWEST	14	9.95	1.42	25	8.95	2.79
PACIFIC EAST AIR	10	.08	125.00			
PAN AMERICAN	28	10.44	2.68	69	11.06	6.24
PEOPLE EXPRESS AIRLINES	11	2.47	4.45	6	1.32	4.55
PIEDMONT	9	7.03	1.28	8	6.10	1.31
REPUBLIC	21	13.18	1.59	13	13.26	.98
SOUTHWEST	5	7.60	.66		6.01	
TEXAS INT'L	6	3.47	1.73	14	2.65	5.28
TRANSAMERICA	6	.56	10.71	1	1.00	1.00
TWA	41	15.10	2.72	67	14.80	4.53
UNITED	35	26.29	1.33	26	22.28	1.17
USAIRb/	26	13.97	1.86	18	12.58	1.43
WESTAIR COMMUTER	5	.49	10.20			
WESTERN	10	8.30	1.20	6	7.21	.83
OTHER U.S. AIRLINES	68	22.96	2.96	129	23.13	5.58

FOREIGN AIRLINES........	FLIGHT PROBLEMS	OVER-SALES	RESERVATIONS AND TICKETING	FARES	REFUNDS	BAGGAGE	CUSTOMER SERVICE	SPECIAL PASSENGERS	SMOKING	ADVER-TISING	CREDIT	TOURS	OTHER	TOTAL
ALITALIA AIRLINES	0	2	0	0	1	0	1	0	1	0	0	0	0	5
MEXICANA	2	2	0	0	0	3	0	0	0	0	0	0	0	7
SABENA	4	0	0	0	0	1	0	0	0	0	0	0	0	5
OTHER FOREIGN AIRLINES	6	11	2	1	17	11	6	0	2	0	0	0	5	61
NOVEMBER 1982 COMPLAINTS	12	15	2	1	18	15	7	0	3	0	0	0	5	78
** PERCENTAGES **	15.4	19.2	2.6	1.3	23.1	19.2	9.0	.0	3.8	.0	.0	.0	6.4	100.0
NOVEMBER 1981 COMPLAINTS	9	14	3	5	6	17	9	2	4	1	0	0	3	73
** PERCENTAGES **	12.3	19.2	4.1	6.8	8.2	23.3	12.3	2.7	5.5	1.4	.0	.0	4.1	100.0

CIVIL AERONAUTICS BOARD CONSUMER COMPLAINT REPORT
FOR THE MONTH OF NOVEMBER 1982

COMPLAINTS BY INDUSTRY GROUP	FLIGHT PROBLEMS	OVER-SALES	RESERVATIONS AND TICKETING	FARES	REFUNDS	BAGGAGE	CUSTOMER SERVICE	SPECIAL PASSENGERS	SMOKING	ADVER-TISING	CREDIT	TOURS	OTHER	TOTAL
U.S. AIRLINES..........														
NOVEMBER 1982 COMPLAINTS	108	53	30	34	80	85	23	2	14	11	5	3	25	473
NOVEMBER 1981 COMPLAINTS	120	70	40	39	55	130	72	7	11	10	5	5	20	584
FOREIGN AIRLINES........														
NOVEMBER 1982 COMPLAINTS	12	15	2	1	18	15	7	0	3	0	0	0	5	78
NOVEMBER 1981 COMPLAINTS	9	14	3	5	6	17	9	2	4	1	0	0	3	73
CARGO/FREIGHT FORWARDERS														
NOVEMBER 1982 COMPLAINTS	0	0	0	0	0	0	0	0	0	1	0	0	1	2
NOVEMBER 1981 COMPLAINTS	0	0	0	0	0	0	0	0	0	0	0	0	6	6
TRAVEL AGENTS...........														
NOVEMBER 1982 COMPLAINTS	1	0	1	1	2	0	0	0	0	0	0	0	1	6
NOVEMBER 1981 COMPLAINTS	1	0	1	0	3	0	0	0	0	0	0	0	0	5
TOUR OPERATORS..........														
NOVEMBER 1982 COMPLAINTS	0	1	0	0	10	1	0	0	0	1	0	16	1	30
NOVEMBER 1981 COMPLAINTS	0	1	0	1	1	0	0	0	0	0	0	9	0	12
OTHER CARRIERS..........														
NOVEMBER 1982 COMPLAINTS	0	2	0	2	1	0	0	0	1	0	0	1	0	7
NOVEMBER 1981 COMPLAINTS	0	0	0	0	0	2	0	0	0	0	1	0	0	3
TOTAL COMPLAINTS........														
NOVEMBER 1982 COMPLAINTS	121	71	33	38	111	101	30	2	18	13	5	20	33	596
** PERCENTAGES **	20.3	11.9	5.5	6.4	18.6	16.9	5.0	.3	3.0	2.2	.8	3.4	5.5	100.0
NOVEMBER 1981 COMPLAINTS	130	85	44	45	65	149	81	9	15	11	6	14	29	683
** PERCENTAGES **	19.0	12.4	6.4	6.6	9.5	21.8	11.9	1.3	2.2	1.6	.9	2.0	4.2	100.0

CIVIL AERONAUTICS BOARD CONSUMER COMPLAINT REPORT[a]
JANUARY 1982 THROUGH NOVEMBER 1982

U.S. AIRLINES[b]	FLIGHT PROBLEMS	OVER-SALES	RESERVATIONS AND TICKETING	FARES	REFUNDS	BAGGAGE	CUSTOMER SERVICE	SPECIAL PASSENGERS	SMOKING	ADVER-TISING	CREDIT	TOURS	OTHER	TOTAL
AERO VIRGIN ISLANDS	2	1	0	0	1	17	3	0	0	0	0	0	0	24
AIR CALIFORNIA	15	7	1	2	1	2	10	1	1	1	0	0	0	41
AIR FLORIDA	48	39	20	15	26	44	22	1	4	2	3	0	4	228
AIR ILLINOIS	0	4	0	1	2	1	1	0	1	0	0	0	0	10
AIR NEW ENGLAND	3	2	0	1	5	0	0	0	0	0	1	0	0	12
AIR WISCONSIN	6	2	0	0	0	3	2	0	0	0	0	0	1	14
ALOHA AIRLINES	0	4	2	1	2	8	1	0	0	0	0	0	1	19
ALTAIR	17	8	2	4	22	12	4	1	1	0	0	0	0	71
AMERICAN	108	74	58	47	32	104	79	9	19	15	15	2	25	586
ARISTA INTERNATIONAL	4	1	0	0	0	1	6	0	0	0	0	1	0	13
ARROW AIRWAYS	8	3	0	0	0	13	0	0	1	1	0	1	2	29
ASPEN	3	3	1	1	2	6	1	0	1	0	0	0	0	18
BAR HARBOR AIRLINES	5	3	2	1	2	3	2	0	0	0	0	0	3	21
BRANIFF INT'L	15	19	6	4	114	50	9	1	3	1	2	0	12	236
BRITT AIRWAYS	4	4	0	0	2	7	1	1	0	0	0	0	0	19
CAPITOL AIR	120	120	21	12	31	82	50	2	5	6	1	0	15	469
CASCADE	4	2	1	2	1	1	0	0	0	0	0	0	0	11
COMAIR	1	2	1	0	0	3	1	0	0	0	0	0	3	11
COMMAND AIRWAYS	3	2	1	0	0	3	2	1	0	0	0	0	0	12
CONTINENTAL	39	24	12	17	14	35	26	2	4	4	3	0	7	187
CROWNAIR	2	1	0	1	1	8	0	0	0	0	0	0	1	14
DELTA	62	22	20	34	17	31	32	4	12	10	4	0	5	253
EASTERN	134	26	34	46	49	93	81	7	12	6	13	2	16	519
EMPIRE	17	13	0	3	0	2	2	0	0	0	0	0	2	39
FRONTIER	18	5	2	8	8	15	6	0	1	0	1	0	9	73
GLOBAL INTERNATIONAL	10	1	0	2	0	4	7	0	3	0	0	2	5	34
GOLDEN WEST AIRLINES	17	5	1	1	4	4	3	0	0	0	0	1	0	36
HAWAIIAN	7	4	2	1	5	9	2	0	0	0	0	0	2	32
IMPERIAL AIRLINES	4	3	0	0	0	7	3	1	0	0	0	0	2	20
JET AMERICA AIRLINES	1	1	1	3	0	2	2	0	0	1	0	0	1	12
METRO AIRLINES	12	3	2	2	1	2	1	0	0	0	0	0	0	23
METRO INTERNATIONAL	10	1	1	0	0	5	3	0	1	0	0	3	1	25
MID PACIFIC AIRLINES	1	2	1	0	0	11	1	1	0	1	0	0	1	19
MIDWAY	11	7	1	1	1	11	3	1	1	0	0	0	0	37
MISSISSIPPI VALLEY	0	5	0	1	2	3	0	0	0	0	0	0	0	11
NEW YORK AIR	35	13	10	5	19	25	12	3	0	0	1	0	2	115
NORTHEASTERN INT'L.	40	46	10	0	62	3	2	0	2	2	3	0	0	170
NORTHWEST	82	24	14	16	22	27	45	3	6	4	2	0	4	249
OCEANAIR LINE	0	1	0	0	0	9	0	0	0	0	0	0	0	10
OVERSEAS NATIONAL AIRWAYS	6	0	0	0	0	1	1	0	1	0	0	3	4	16
OZARK	13	4	2	4	5	9	6	1	2	0	0	1	1	48
PACIFIC EAST AIR	9	11	3	2	14	2	2	0	0	0	0	0	0	43
PAN AMERICAN	105	87	30	29	63	127	62	8	20	6	4	1	26	565
PEOPLE EXPRESS AIRLINES	51	33	16	24	5	16	15	3	0	1	0	0	3	167
PIEDMONT	23	23	4	6	19	13	7	2	1	0	1	0	4	94
PILGRIM AIRLINES	7	3	1	0	0	1	2	0	1	0	0	0	0	15
PIONEER	4	2	0	0	2	3	1	0	0	0	0	0	0	12
PRECISION	7	6	0	0	4	0	1	0	0	0	1	0	0	19
PRO AIR SERVICES	5	1	0	1	1	1	1	0	0	0	0	0	1	11
PSA	18	9	2	3	3	10	4	1	1	1	0	0	2	54

CIVIL AERONAUTICS BOARD CONSUMER COMPLAINT REPORT a/
JANUARY 1982 THROUGH NOVEMBER 1982

U.S. AIRLINES b/	FLIGHT PROBLEMS	OVER-SALES	RESERVATIONS AND TICKETING	FARES	REFUNDS	BAGGAGE	CUSTOMER SERVICE	SPECIAL PASSENGERS	SMOKING	ADVER-TISING	CREDIT	TOURS	OTHER	TOTAL
PRINAIR	1	3	1	0	0	20	1	0	0	0	0	0	1	27
REPUBLIC	90	71	13	26	26	39	41	3	4	12	4	0	19	348
RIO AIRWAYS	6	0	1	0	3	4	3	0	0	0	0	0	0	17
ROCKY MOUNTAIN	3	2	1	0	1	3	2	1	0	0	0	0	0	13
ROYALE	5	2	0	0	0	1	6	0	0	0	0	0	0	14
SIMMONS AIRLINES	3	3	1	0	0	4	0	0	0	0	0	0	0	11
SOUTH PACIFIC ISLAND	1	8	2	0	2	13	5	0	0	0	0	0	3	34
SOUTHWEST	12	14	8	1	4	11	7	1	2	0	1	0	3	64
SUN AIRE	3	9	1	0	0	10	2	1	0	0	0	0	1	27
TEXAS INT'L	26	34	10	10	18	19	16	2	5	1	0	0	4	145
THE FLYING TIGER LINE	0	0	0	0	0	1	0	0	0	0	0	0	12	13
TRANSAMERICA	8	3	1	1	1	2	5	0	1	0	0	3	0	25
TWA	188	114	42	54	57	171	133	12	43	9	15	5	24	867
UNITED	157	87	28	50	38	119	79	10	29	4	8	0	34	643
USAIR c/	99	48	8	21	10	64	32	8	8	3	1	0	8	310
WESTAIR COMMUTER	11	16	2	0	3	11	6	1	1	1	0	0	2	54
WESTERN	21	20	14	18	27	27	20	3	4	12	5	0	7	178
WIEN AIR ALASKA	3	2	1	1	1	3	1	0	1	0	0	0	1	14
WINGS WEST	6	5	0	1	0	1	2	0	0	0	0	0	1	16
WORLD	43	29	8	11	21	28	19	3	2	1	0	0	2	167
OTHER U.S. AIRLINES	80	73	15	10	42	63	17	2	1	4	0	4	15	324
CURRENT PERIOD TOTALS	1882	1229	442	505	797	1463	924	100	205	109	89	29	305	8079
** PERCENTAGES **	23.3	15.2	5.5	6.3	9.9	18.1	11.4	1.2	2.5	1.3	1.1	.4	3.8	100.0
SAME PERIOD PRIOR YEAR	2470	1211	562	519	783	2229	1252	120	295	107	99	35	421	10202
** PERCENTAGES **	24.2	11.9	5.5	6.1	7.7	21.8	12.3	1.2	2.9	1.0	1.0	.3	4.1	100.0

	CURRENT PERIOD			SAME PERIOD PRIOR YEAR		
U.S. AIRLINES..........	TOTAL COMPLAINTS	PASSENGERS FLOWN (100,000)d/	COMPLAINTS PER 100,000 PASSENGERS	TOTAL COMPLAINTS	PASSENGERS FLOWN (100,000)d/	COMPLAINTS PER 100,000 PASSENGERS
AERO VIRGIN ISLANDS	24			27		
AIR CALIFORNIA	41	32.51	1.26	70	31.67	2.21
AIR FLORIDA	228	27.25	8.37	383	28.77	13.31
AIR ILLINOIS	10			7		
AIR NEW ENGLAND	12			32		
AIR WISCONSIN	14	6.69	2.09	30	6.32	4.75
ALOHA AIRLINES	19	23.25	.82	19	12.80	1.48
ALTAIR	71	4.90	14.49	35	3.06	11.44
AMERICAN	586	247.19	2.37	682	225.21	3.03
ARISTA INTERNATIONAL	13					
ARROW AIRWAYS	29					
ASPEN	18	2.78	6.47	25	2.55	9.80
BAR HARBOR AIRLINES	21			18		
BRANIFF INT'L	236	56.91	4.15	443	97.78	4.53
BRITT AIRWAYS	19			33	3.20	10.31
CAPITOL AIR	468	16.34	28.64	331	9.57	34.59
CASCADE	11	2.34	4.70	6	2.21	2.71
COMAIR	11			13		
COMMAND AIRWAYS	12			6		
CONTINENTAL	187	83.28	2.25	212	74.07	2.86
CROWNAIR	14			4		
DELTA	253	306.61	.83	289	325.79	.89
EASTERN	519	320.88	1.62	848	332.49	2.55
EMPIRE	39	4.91	7.94	29	3.28	8.84
FRONTIER	73	55.23	1.32	109	57.49	1.90
GLOBAL INTERNATIONAL	34			2		
GOLDEN WEST AIRLINES	36	5.09	7.07	39	5.96	6.54
HAWAIIAN	32	29.46	1.09	36	27.56	1.31
IMPERIAL AIRLINES	20	1.87	10.70	21	1.25	16.80
JET AMERICA AIRLINES	12	1.32	9.09	1		
METRO AIRLINES	23			6		
METRO INTERNATIONAL	25			30		
MID PACIFIC AIRLINES	19			3		
MIDWAY	37	10.95	3.38	23	4.79	4.80
MISSISSIPPI VALLEY	11	3.91	2.81	25	2.95	8.47
NEW YORK AIR	116	16.32	7.11	140	10.49	13.35
NORTHEASTERN INT'L.	170	.64	265.63			
NORTHWEST	249	101.51	2.45	292	104.46	2.80
OCEANAIR LINE	10			23		
OVERSEAS NATIONAL AIRWAYS	16					
OZARK	48	39.99	1.20	78	39.36	1.98
PACIFIC EAST AIR	43	.08	537.50			
PAN AMERICAN	565	120.16	4.70	1168	127.76	9.14
PEOPLE EXPRESS AIRLINES	167	22.71	7.35	57	5.02	11.35
PIEDMONT	94	75.17	1.25	88	62.70	1.40
PILGRIM AIRLINES	15			27		
PIONEER	12			12		
PRECISION	19			10		
PRO AIR SERVICES	11			1		
PSA	54	63.27	.85	109	50.42	2.15

CIVIL AERONAUTICS BOARD CONSUMER COMPLAINT REPORT
JANUARY 1982 THROUGH NOVEMBER 1982

U.S. AIRLINES...........	CURRENT PERIOD: TOTAL COMPLAINTS	CURRENT PERIOD: PASSENGERS FLOWN (100,000)d/	CURRENT PERIOD: COMPLAINTS PER 100,000 PASSENGERS	SAME PERIOD PRIOR YEAR: TOTAL COMPLAINTS	SAME PERIOD PRIOR YEAR: PASSENGERS FLOWN (100,000)d/	SAME PERIOD PRIOR YEAR: COMPLAINTS PER 100,000 PASSENGERS
PRINAIR	27			83		
REPUBLIC	348	166.96	2.08	404	146.23	2.76
RIO AIRWAYS	17			16		
ROCKY MOUNTAIN	13	3.31	3.93	23	.71	32.39
ROYALE	14			6		
SIMMONS AIRLINES	11					
SOUTH PACIFIC ISLAND	34	.20	170.00	4	.29	13.79
SOUTHWEST	64	78.36	.82	55	70.29	.78
SUN AIRE	27			10		
TEXAS INT'L	145	40.08	3.62	239	36.69	6.51
THE FLYING TIGER LINE	13	3.55	3.66	2	3.26	.61
TRANSAMERICA	25	4.85	5.15	44	7.87	5.59
TWA	867	161.92	5.35	1129	167.48	6.74
UNITED	643	297.85	2.16	613	269.19	2.28
USAIRe/	310	152.36	2.03	432	147.55	2.93
WESTAIR COMMUTER	54	3.30	16.36	13		
WESTERN	178	88.45	2.01	166	86.32	1.92
WIEN AIR ALASKA	14	9.20	1.52	13	8.43	1.54
WINGS WEST	16			3		
WORLD	167	15.82	10.56	437	18.51	23.61
OTHER U.S. AIRLINES	326	32.50	10.03	668	44.92	14.87

CIVIL AERONAUTICS BOARD CONSUMER COMPLAINT REPORT
JANUARY 1982 THROUGH NOVEMBER 1982

FOREIGN AIRLINES........	FLIGHT PROBLEMS	OVER-SALES	RESERVATIONS AND TICKETING	FARES	REFUNDS	BAGGAGE	CUSTOMER SERVICE	SPECIAL PASSENGERS	SMOKING	ADVER-TISING	CREDIT	TOURS	OTHER	TOTAL
AER LINGUS	3	3	0	1	2	3	1	1	0	0	0	1	0	15
AEROMEXICO	11	14	3	0	3	17	10	0	1	0	0	0	5	64
AIR CANADA	1	0	0	0	7	2	3	0	2	0	0	0	0	15
AIR FRANCE	8	3	0	1	3	11	5	0	2	0	0	0	4	37
AIR INDIA	2	9	1	2	2	7	3	0	0	0	0	0	0	26
AIR JAMAICA	2	8	1	0	5	3	1	0	0	0	0	0	2	22
ALITALIA AIRLINES	4	9	2	3	7	10	4	0	2	0	0	0	1	42
ALIA JORDANIAN AIRLINES	0	1	0	0	1	11	0	0	1	0	0	0	1	15
AVIANCA	4	6	0	1	5	1	1	1	0	0	0	0	2	21
BAHAMASAIR	4	1	0	1	1	7	1	0	0	0	0	0	0	15
BRITISH AIRWAYS	12	15	7	4	2	18	9	0	3	1	0	0	1	72
BRITISH CALEDONIAN AIRWAY	1	2	3	2	0	0	3	0	2	0	0	0	0	13
BWIA	6	1	0	0	0	5	1	0	0	0	0	0	0	13
DOMINICANA DE AVIACION	1	5	0	0	0	5	1	0	0	0	0	0	1	13
EL AL ISRAEL	3	3	0	0	1	3	1	0	0	0	1	0	0	12
FAUCETT, S.A.	0	1	0	1	4	6	0	0	0	0	0	0	1	13
IBERIA AIRLINES	2	13	0	2	6	12	3	1	2	0	0	0	1	42
ICELANDAIR	1	6	0	1	1	1	0	0	0	1	0	0	0	11
KOREAN AIRLINES	1	2	2	1	3	7	3	0	0	0	0	1	3	23
KUWAIT AIRWAYS	2	1	3	0	0	7	4	0	0	0	0	0	0	17
KLM	3	7	7	3	5	9	3	0	2	0	0	0	3	42
LAKER AIRWAYS	0	0	1	0	22	0	0	0	0	0	0	0	2	25
LUFTHANSA	5	2	1	5	4	9	3	0	5	0	1	0	2	37
LACSA	0	2	1	0	2	8	0	0	0	0	0	0	0	13
MEXICANA	9	24	2	0	4	28	8	3	0	0	1	1	3	83
OLYMPIC AIRWAYS	4	3	3	2	2	5	4	0	0	0	0	0	0	23
PAKISTAN INTERNATIONAL	0	2	0	0	5	6	0	0	0	0	0	0	1	14
PHILIPPINE AIRLINES	0	0	0	1	2	5	0	0	0	0	0	0	2	10
ROYAL AIR MAROC	1	5	0	1	0	3	1	0	3	0	0	0	0	14
SABENA	7	0	2	0	2	7	1	0	3	0	0	0	0	22
SINGAPORE AIRLINES	0	3	0	0	3	3	0	0	0	0	0	0	1	10
SWISSAIR	1	2	0	2	0	1	2	0	0	0	0	0	3	11
SAHSA	1	0	0	0	1	4	3	0	0	0	0	0	1	10
SAS	2	4	2	2	0	1	1	0	2	0	0	0	0	14
VIASA	0	2	0	0	2	6	1	0	0	0	0	0	2	13
OTHER FOREIGN AIRLINES	24	22	9	5	27	52	8	1	3	0	0	3	15	169
CURRENT PERIOD TOTALS	125	181	50	41	134	283	89	7	33	2	3	6	57	1011
** PERCENTAGES **	12.4	17.9	4.9	4.1	13.3	28.0	8.8	.7	3.3	.2	.3	.6	5.6	100.0
SAME PERIOD PRIOR YEAR	241	241	73	86	149	463	151	4	39	12	0	6	85	1550
** PERCENTAGES **	15.5	15.5	4.7	5.5	9.6	29.9	9.7	.3	2.5	.8	.0	.4	5.5	100.0

CIVIL AERONAUTICS BOARD CONSUMER COMPLAINT REPORT
JANUARY 1982 THROUGH NOVEMBER 1982

COMPLAINTS BY INDUSTRY GROUP	FLIGHT PROBLEMS	OVER-SALES	RESERVATIONS AND TICKETING	FARES	REFUNDS	BAGGAGE	CUSTOMER SERVICE	SPECIAL PASSENGERS	SMOKING	ADVER-TISING	CREDIT	TOURS	OTHER	TOTAL
U.S. AIRLINES............														
CURRENT PERIOD TOTALS	1882	1229	442	505	797	1463	924	100	205	109	89	29	305	8079
SAME PERIOD PRIOR YEAR	2470	1211	562	618	783	2229	1252	120	295	107	99	35	421	10202
FOREIGN AIRLINES........														
CURRENT PERIOD TOTALS	125	181	50	41	134	283	89	7	33	2	3	6	57	1011
SAME PERIOD PRIOR YEAR	241	241	73	86	149	463	151	4	39	12	0	6	85	1550
CARGO/FREIGHT FORWARDERS														
CURRENT PERIOD TOTALS	0	0	0	1	0	1	0	0	0	1	0	0	35	39
SAME PERIOD PRIOR YEAR	0	0	0	0	1	0	0	0	0	0	0	0	99	100
TRAVEL AGENTS...........														
CURRENT PERIOD TOTALS	4	3	23	15	29	1	3	0	0	0	1	27	2	108
SAME PERIOD PRIOR YEAR	5	0	43	13	41	3	2	0	0	2	3	19	3	134
TOUR OPERATORS..........														
CURRENT PERIOD TOTALS	6	17	11	5	26	10	8	0	0	8	1	237	6	335
SAME PERIOD PRIOR YEAR	9	7	15	6	29	9	4	0	1	6	2	226	2	316
OTHER CARRIERS..........														
CURRENT PERIOD TOTALS	0	4	0	3	1	3	1	2	2	0	0	1	5	22
SAME PERIOD PRIOR YEAR	6	4	2	16	2	13	5	2	38	2	2	2	49	142
TOTAL COMPLAINTS........														
CURRENT PERIOD TOTALS	2017	1434	526	570	987	1761	1025	109	240	120	94	300	410	9593
** PERCENTAGES **	21.0	14.9	5.5	5.9	10.3	18.4	10.7	1.1	2.5	1.3	1.0	3.1	4.3	100.0
SAME PERIOD PRIOR YEAR	2731	1463	695	739	1005	2717	1414	126	373	129	106	288	658	12444
** PERCENTAGES **	21.9	11.8	5.6	5.9	8.1	21.8	11.4	1.0	3.0	1.0	.9	2.3	5.3	100.0

CIVIL AERONAUTICS BOARD CONSUMER COMPLAINT REPORT a/
FOR THE MONTH OF DECEMBER 1982

U.S. AIRLINES b/	FLIGHT PROBLEMS	OVER-SALES	RESERVATIONS AND TICKETING	FARES	REFUNDS	BAGGAGE	CUSTOMER SERVICE	SPECIAL PASSENGERS	SMOKING	ADVER-TISING	CREDIT	TOURS	OTHER	TOTAL
AIR FLORIDA	0	2	1	0	1	1	0	0	0	0	0	0	0	5
ALTAIR	0	0	0	0	10	0	0	0	0	0	0	0	0	10
AMERICAN	8	7	0	5	2	5	7	3	6	1	2	0	2	48
BRANIFF INT'L	0	0	0	0	5	0	0	0	0	0	0	0	1	6
CAPITOL AIR	11	0	0	0	5	3	1	0	0	0	0	0	0	20
CONTINENTAL	6	2	1	2	2	2	1	0	0	0	0	0	1	17
DELTA	4	3	0	0	0	2	1	0	0	2	0	0	0	12
EASTERN	8	3	0	3	10	3	1	1	0	0	0	0	2	31
FRONTIER	2	2	0	0	2	0	0	0	0	0	0	0	0	6
NORTHEASTERN INT'L.	3	0	0	0	4	0	0	0	0	0	0	0	0	7
NORTHWEST	10	1	2	0	0	4	2	0	0	0	0	0	1	20
PACIFIC EAST AIR	2	0	0	0	7	0	0	0	0	0	0	0	0	9
PAN AMERICAN.	4	4	2	0	2	7	3	0	3	0	0	0	2	27
PEOPLE EXPRESS AIRLINES	7	1	0	2	0	0	1	0	0	0	0	0	0	11
PIEDMONT	2	5	0	0	1	0	1	0	2	0	0	0	0	11
PSA	0	2	0	0	0	2	0	0	1	0	0	0	0	5
REPUBLIC	5	3	1	0	3	1	0	0	2	1	0	0	2	18
TRANSAMERICA	2	0	0	0	0	0	0	1	0	1	0	0	1	5
TWA	8	6	3	5	2	6	3	3	3	0	3	1	2	45
UNITED	13	8	4	6	6	5	4	2	1	0	1	0	2	52
USAIR c/	6	2	1	0	2	5	2	0	2	0	0	0	1	21
WESTAIR COMMUTER	1	3	0	0	1	0	1	0	0	0	0	0	0	6
WESTERN	1	2	2	1	5	1	0	1	0	2	0	0	2	17
WORLD	3	2	0	0	0	2	0	0	0	0	0	0	0	7
OTHER U.S. AIRLINES	22	9	0	1	11	13	4	2	1	4	0	0	3	70
DECEMBER 1982 COMPLAINTS	128	67	17	26	91	62	32	13	21	11	6	1	22	487
** PERCENTAGES **	26.3	13.8	3.5	5.3	18.7	12.7	6.6	2.7	4.3	2.3	1.2	.2	4.5	100.0
DECEMBER 1981 COMPLAINTS	160	81	36	39	48	125	67	3	18	7	4	3	33	624
** PERCENTAGES **	25.6	13.0	5.8	6.3	7.7	20.0	10.7	.5	2.9	1.1	.6	.5	5.3	100.0

CIVIL AERONAUTICS BOARD CONSUMER COMPLAINT REPORT
FOR THE MONTH OF DECEMBER 1982

U.S. AIRLINES...........	DECEMBER 1982 TOTAL COMPLAINTS	DECEMBER 1982 PASSENGERS FLOWN (100,000)	DECEMBER 1982 COMPLAINTS PER 100,000 PASSENGERS	DECEMBER 1981 TOTAL COMPLAINTS	DECEMBER 1981 PASSENGERS FLOWN (100,000)	DECEMBER 1981 COMPLAINTS PER 100,000 PASSENGERS
AIR FLORIDA	5	1.60	3.13	20	2.58	7.75
ALTAIR	10			6	.52	11.54
AMERICAN	49	22.83	2.15	31	21.09	1.47
BRANIFF INT'L	6			19	8.25	2.30
CAPITOL AIR	20	1.36	14.71	40	1.07	37.38
CONTINENTAL	17	5.91	2.88	13	7.42	1.75
DELTA	12	26.74	.45	23	27.77	.83
EASTERN	31	28.97	1.07	34	28.24	1.20
FRONTIER	6	4.34	1.38	7	5.11	1.37
NORTHEASTERN INT'L.	7	.10	70.00			
NORTHWEST	20	10.26	1.95	10	9.01	1.11
PACIFIC EAST AIR	9	.07	128.57			
PAN AMERICAN	27	10.15	2.66	51	11.14	4.58
PEOPLE EXPRESS AIRLINES	11	3.05	3.61	9	1.41	6.38
PIEDMONT	11	7.51	1.46	9	6.84	1.32
PSA	5	6.42	.78	9	5.56	1.62
REPUBLIC	18	14.42	1.25	37	13.65	2.71
TRANSAMERICA	5	.41	12.20	2	.70	2.86
TWA	45	14.90	3.02	58	15.19	3.82
UNITED	52	28.78	1.81	49	23.75	2.06
USAIR	21	15.41	1.36	32	14.15	2.26
WESTAIR COMMUTER	6	.48	12.50	3		
WESTERN	17	7.84	2.17	17	7.04	2.41
WORLD	7	1.51	4.64	14	1.61	8.70
OTHER U.S. AIRLINES	70	27.26	2.57	131	26.51	4.94

CIVIL AERONAUTICS BOARD CONSUMER COMPLAINT REPORT
FOR THE MONTH OF DECEMBER 1982

FOREIGN AIRLINES........	FLIGHT PROBLEMS	OVER-SALES	RESERVATIONS AND TICKETING	FARES	REFUNDS	BAGGAGE	CUSTOMER SERVICE	SPECIAL PASSENGERS	SMOKING	ADVER-TISING	CREDIT	TOURS	OTHER	TOTAL
AEROMEXICO	3	1	0	0	0	0	0	0	1	0	0	0	0	5
OTHER FOREIGN AIRLINES	5	8	1	0	10	8	2	0	0	0	0	1	1	36
DECEMBER 1982 COMPLAINTS	8	9	1	0	10	8	2	0	1	0	0	1	1	41
** PERCENTAGES **	19.5	22.0	2.4	.0	24.4	19.5	4.9	.0	2.4	.0	.0	2.4	2.4	100.0
DECEMBER 1981 COMPLAINTS	19	14	6	8	12	23	9	0	0	1	0	0	3	95
** PERCENTAGES **	20.0	14.7	6.3	8.4	12.6	24.2	9.5	.0	.0	1.1	.0	.0	3.2	100.0

CIVIL AERONAUTICS BOARD CONSUMER COMPLAINT REPORT
FOR THE MONTH OF DECEMBER 1982

COMPLAINTS BY INDUSTRY GROUP	FLIGHT PROBLEMS	OVER-SALES	RESERVATIONS AND TICKETING	FARES	REFUNDS	BAGGAGE	CUSTOMER SERVICE	SPECIAL PASSENGERS	SMOKING	ADVER-TISING	CREDIT	TOURS	OTHER	TOTAL
U.S. AIRLINES..........														
DECEMBER 1982 COMPLAINTS	128	67	17	26	81	62	32	13	21	11	6	1	22	487
DECEMBER 1981 COMPLAINTS	160	81	36	39	48	125	67	3	18	7	4	3	33	624
FOREIGN AIRLINES........														
DECEMBER 1982 COMPLAINTS	8	9	1	0	10	8	2	0	1	0	0	1	1	41
DECEMBER 1981 COMPLAINTS	19	14	6	8	12	23	9	0	0	1	0	0	3	95
CARGO/FREIGHT FORWARDERS														
DECEMBER 1982 COMPLAINTS	0	0	0	0	0	0	0	0	0	0	0	0	2	2
DECEMBER 1981 COMPLAINTS	0	0	0	0	0	0	0	0	0	0	0	0	5	5
TRAVEL AGENTS..........														
DECEMBER 1982 COMPLAINTS	0	0	0	3	2	0	0	0	0	0	0	0	0	5
DECEMBER 1981 COMPLAINTS	1	0	0	1	2	0	0	0	0	0	0	1	1	6
TOUR OPERATORS.........														
DECEMBER 1982 COMPLAINTS	0	1	2	1	4	0	0	0	0	0	0	8	0	16
DECEMBER 1981 COMPLAINTS	1	1	0	1	0	0	0	0	0	0	0	7	0	10
OTHER CARRIERS.........														
DECEMBER 1982 COMPLAINTS	0	2	0	0	0	3	0	0	0	0	0	0	2	7
DECEMBER 1981 COMPLAINTS	1	1	0	2	0	1	0	0	0	0	0	0	0	5
TOTAL COMPLAINTS........														
DECEMBER 1982 COMPLAINTS	136	79	20	30	97	73	34	13	22	11	6	10	27	558
** PERCENTAGES **	24.4	14.2	3.6	5.4	17.4	13.1	6.1	2.3	3.9	2.0	1.1	1.8	4.8	100.0
DECEMBER 1981 COMPLAINTS	182	97	42	51	62	149	76	3	18	8	4	11	42	745
** PERCENTAGES **	24.4	13.0	5.6	6.8	8.3	20.0	10.2	.4	2.4	1.1	.5	1.5	5.6	100.0

CIVIL AERONAUTICS BOARD CONSUMER COMPLAINT REPORT a/
TWELVE MONTHS ENDING DECEMBER 1982

U.S. AIRLINES b/	FLIGHT PROBLEMS	OVER-SALES	RESERVATIONS AND TICKETING	FARES	REFUNDS	BAGGAGE	CUSTOMER SERVICE	SPECIAL PASSENGERS	SMOKING	ADVER-TISING	CREDIT	TOURS	OTHER	TOTAL
AERO VIRGIN ISLANDS	2	1	0	0	1	17	3	0	0	0	0	0	0	24
AIR CALIFORNIA	15	7	1	2	1	2	10	1	1	1	0	0	0	41
AIR FLORIDA	48	41	21	15	27	45	22	1	4	2	3	0	4	233
AIR ILLINOIS	0	5	0	1	2	1	1	0	1	0	0	0	0	11
AIR NEW ENGLAND	3	2	0	1	5	0	0	0	0	0	1	0	0	12
AIR VIRGINIA	2	5	0	0	0	1	2	0	0	0	0	0	0	10
AIR WISCONSIN	6	2	0	0	0	3	2	0	0	0	0	0	1	14
ALOHA AIRLINES	0	4	2	1	2	8	1	0	0	0	0	0	2	20
ALTAIR	17	8	2	4	32	12	4	1	1	0	0	0	0	81
AMERICAN	116	81	58	53	34	109	86	11	25	15	17	2	27	635
AMERICAN CENTRAL AIRLINES	0	6	0	1	1	3	0	0	0	0	0	0	0	11
ARISTA INTERNATIONAL	4	1	0	0	0	1	6	0	0	0	0	1	0	13
ARROW AIRWAYS	9	3	0	0	0	13	0	0	2	1	0	1	3	32
ASPEN	3	3	1	1	2	6	1	0	1	0	0	0	0	18
BAR HARBOR AIRLINES	5	3	2	1	2	3	2	0	0	0	0	0	3	21
BRANIFF INT'L	15	19	6	4	119	50	9	1	3	1	2	0	13	242
BRITT AIRWAYS	4	4	0	0	3	7	1	1	0	0	0	0	0	20
CAPITOL AIR	131	120	21	12	36	85	51	2	5	6	1	0	18	489
CASCADE	4	2	1	2	1	1	0	0	0	0	0	0	0	11
COMAIR	1	2	1	0	0	3	1	0	0	0	0	0	3	11
COMMAND AIRWAYS	3	2	1	0	0	3	2	1	0	0	0	0	0	12
CONTINENTAL	45	26	13	19	16	37	27	2	4	4	3	0	9	204
CROWNAIR	2	1	0	1	1	8	0	0	0	0	0	0	1	14
DELTA	66	25	20	34	17	33	33	4	12	12	4	0	5	265
EASTERN	142	29	34	49	59	96	82	8	12	6	13	2	18	550
EMPIRE	18	13	0	3	0	2	2	0	0	0	0	0	2	40
FRONTIER	20	7	2	8	10	15	6	0	1	0	1	0	9	79
GLOBAL INTERNATIONAL	11	1	0	2	0	4	7	0	3	0	0	2	5	35
GOLDEN WEST AIRLINES	18	5	1	1	5	4	3	0	0	0	0	1	0	39
HAWAII EXPRESS	5	0	1	0	0	0	0	0	0	3	0	0	1	10
HAWAIIAN	7	4	2	1	5	10	2	0	0	0	0	0	2	33
IMPERIAL AIRLINES	4	4	0	0	0	7	3	1	0	0	0	0	3	22
JET AMERICA AIRLINES	1	1	1	3	0	2	2	0	0	1	0	0	1	12
METRO AIRLINES	12	3	2	2	1	3	1	0	0	0	0	0	0	24
METRO INTERNATIONAL	11	1	1	0	0	5	3	1	1	0	0	3	1	27
MID PACIFIC AIRLINES	1	4	1	0	0	11	1	1	0	1	0	0	1	21
MIDWAY	12	7	1	1	1	11	3	1	1	0	0	0	0	38
MISSISSIPPI VALLEY	0	5	0	1	2	3	0	1	0	0	0	0	0	12
NEW YORK AIR	36	13	10	5	11	25	12	3	0	0	1	0	2	118
NORTHEASTERN INT'L.	43	46	10	0	66	3	2	0	2	2	3	0	0	177
NORTHWEST	92	23	16	16	22	31	47	3	6	4	2	0	5	269
OCEANAIR LINE	1	1	0	0	0	10	0	0	0	0	0	0	0	12
OVERSEAS NATIONAL AIRWAYS	6	1	0	0	0	1	1	0	1	0	0	3	4	17
OZARK	13	4	2	4	6	9	6	1	2	0	0	1	1	49
PACIFIC EAST AIR	11	11	3	2	21	2	2	0	0	0	0	0	0	52
PAN AMERICAN	109	91	32	29	62	134	65	8	23	6	4	1	28	592
PEOPLE EXPRESS AIRLINES	59	34	16	26	5	14	16	3	0	1	0	0	3	178
PIEDMONT	25	28	4	6	11	13	8	2	3	0	1	0	4	105
PILGRIM AIRLINES	4	3	1	0	0	1	2	0	1	0	0	0	0	16
PIONEER	4	2	0	0	2	3	1	0	0	0	0	0	0	12

CIVIL AERONAUTICS BOARD CONSUMER COMPLAINT REPORT [a]
TWELVE MONTHS ENDING DECEMBER 1982

U.S. AIRLINES [b]..........	FLIGHT PROBLEMS	OVER-SALES	RESERVATIONS AND TICKETING	FARES	REFUNDS	BAGGAGE	CUSTOMER SERVICE	SPECIAL PASSENGERS	SMOKING	ADVER-TISING	CREDIT	TOURS	OTHER	TOTAL
POMPANO AIRWAYS	1	0	0	1	4	4	0	0	0	0	0	0	0	10
PRECISION	9	6	0	0	4	0	2	0	0	0	1	0	0	22
PRO AIR SERVICES	6	1	0	1	1	1	1	0	0	0	0	0	1	12
PSA	18	11	2	3	3	12	4	1	2	1	0	0	2	59
PRINAIR	1	3	1	0	0	22	2	0	0	0	0	0	1	30
REPUBLIC	95	74	14	26	29	40	41	3	6	13	4	0	21	366
RIO AIRWAYS	6	0	1	0	3	4	3	0	0	0	0	0	0	17
ROCKY MOUNTAIN	3	2	1	0	1	3	2	1	0	0	0	0	0	13
ROYALE	5	2	0	0	0	1	6	0	0	0	0	0	0	14
SIMMONS AIRLINES	3	3	1	0	0	4	0	0	0	0	0	0	0	11
SOUTH PACIFIC ISLAND	1	8	2	0	2	14	5	0	0	0	0	0	3	35
SOUTHWEST	13	14	8	1	5	12	7	1	2	0	1	0	3	67
SUN AIRE	3	9	1	0	0	10	2	1	0	0	0	0	1	27
TEXAS INT'L	26	34	10	11	19	19	16	2	5	1	0	0	4	147
THE FLYING TIGER LINE	0	0	0	0	0	1	0	0	0	0	0	0	12	13
TRANSAMERICA	10	3	1	1	1	2	5	1	1	1	0	3	1	30
TWA	196	120	45	59	59	177	136	15	46	9	18	6	26	912
UNITED	170	95	32	56	44	124	83	12	30	4	9	0	36	695
USAIR [c]	105	50	9	21	12	69	34	8	10	3	1	0	9	331
WESTAIR COMMUTER	12	19	2	0	4	11	7	1	1	1	0	0	2	60
WESTERN	22	22	16	19	32	28	20	4	4	14	5	0	9	195
WIEN AIR ALASKA	3	2	1	1	1	4	1	0	1	0	0	0	1	15
WINGS WEST	6	5	0	1	0	1	2	0	0	0	0	0	1	16
WORLD	46	31	8	11	21	30	19	3	2	1	0	0	2	174
OTHER U.S. AIRLINES	81	66	14	8	42	60	17	2	1	5	0	4	14	314
1982 COMPLAINTS	2010	1296	459	531	979	1525	956	113	226	120	95	30	327	9566
** PERCENTAGES **	23.5	15.1	5.4	6.2	10.2	17.8	11.2	1.3	2.6	1.4	1.1	.4	3.8	100.0
1981 COMPLAINTS	2630	1292	598	557	831	2354	1319	123	313	114	103	38	454	10826
** PERCENTAGES **	24.3	11.9	5.5	5.1	7.7	21.7	12.2	1.1	2.9	1.1	1.0	.4	4.2	100.0

CIVIL AERONAUTICS BOARD CONSUMER COMPLAINT REPORT
TWELVE MONTHS ENDING DECEMBER 1982

U.S. AIRLINES............	1982 TOTAL COMPLAINTS	1982 PASSENGERS FLOWN (100,000)d/	1982 COMPLAINTS PER 100,000 PASSENGERS	1981 TOTAL COMPLAINTS	1981 PASSENGERS FLOWN (100,000)d/	1981 COMPLAINTS PER 100,000 PASSENGERS
AERO VIRGIN ISLANDS	24			31		
AIR CALIFORNIA	41	35.73	1.15	75	34.85	2.15
AIR FLORIDA	233	28.85	8.08	403	31.35	12.85
AIR ILLINOIS	11			8		
AIR NEW ENGLAND	12			33		
AIR VIRGINIA	10			5		
AIR WISCONSIN	14	6.69	2.09	30	7.01	4.28
ALOHA AIRLINES	20	25.20	.79	21	15.03	1.40
ALTAIR	81	4.93	16.53	41	3.58	11.45
AMERICAN	635	269.93	2.35	713	246.30	2.89
AMERICAN CENTRAL AIRLINES	11			2		
ARISTA INTERNATIONAL	13					
ARROW AIRWAYS	32					
ASPEN	18	2.78	6.47	28	2.72	10.29
BAR HARBOR AIRLINES	21			19		
BRANIFF INT'L	242	56.91	4.25	462	106.03	4.36
BRITT AIRWAYS	20			33	3.20	10.31
CAPITOL AIR	488	17.70	27.57	371	10.64	34.97
CASCADE	11	2.34	4.70	6	2.41	2.49
COMAIR	11			15		
COMMAND AIRWAYS	12			6		
CONTINENTAL	204	89.19	2.29	225	81.49	2.76
CROWNAIR	14			4		
DELTA	265	333.35	.79	312	353.57	.88
EASTERN	550	349.87	1.57	882	360.74	2.44
EMPIRE	40	5.43	7.37	36	3.67	9.81
FRONTIER	79	59.57	1.33	116	62.60	1.85
GLOBAL INTERNATIONAL	35			3		
GOLDEN WEST AIRLINES	38	5.09	7.47	45	6.56	6.86
HAWAII EXPRESS	10					
HAWAIIAN	33	31.84	1.04	40	29.89	1.34
IMPERIAL AIRLINES	22	1.97	11.76	25	1.47	17.01
JET AMERICA AIRLINES	12	1.32	9.09	1		
METRO AIRLINES	24			6		
METRO INTERNATIONAL	27			30		
MID PACIFIC AIRLINES	21			4		
MIDWAY	38	12.39	3.15	28	5.70	4.91
MISSISSIPPI VALLEY	12	3.91	3.07	25	3.32	7.53
NEW YORK AIR	118	17.96	6.61	161	12.41	12.97
NORTHEASTERN INT'L.	177	.74	239.19			
NORTHWEST	269	111.77	2.41	302	113.47	2.65
OCEANAIR LINE	12			23		
OVERSEAS NATIONAL AIRWAYS	17					
OZARK	49	43.70	1.12	85	42.79	1.99
PACIFIC EAST AIR	52	.15	325.33			
PAN AMERICAN	592	139.31	4.54	1219	138.89	3.78
PEOPLE EXPRESS AIRLINES	178	25.76	6.91	66	6.43	10.26
PIEDMONT	105	82.67	1.27	97	69.54	1.39
PILGRIM AIRLINES	16			29		
PIONEER	12			12		

CIVIL AERONAUTICS BOARD CONSUMER COMPLAINT REPORT
TWELVE MONTHS ENDING DECEMBER 1982

U.S. AIRLINES..........	1982 TOTAL COMPLAINTS	1982 PASSENGERS FLOWN (100,000)d/	1982 COMPLAINTS PER 100,000 PASSENGERS	1981 TOTAL COMPLAINTS	1981 PASSENGERS FLOWN (100,000)d/	1981 COMPLAINTS PER 100,000 PASSENGERS
POMPANO AIRWAYS	10					
PRECISION	22			10		
PRO AIR SERVICES	12			1		
PSA	59	69.69	.85	118	55.98	2.11
PRINAIR	30			86		
REPUBLIC	366	181.39	2.02	441	159.88	2.76
RIO AIRWAYS	17			16		
ROCKY MOUNTAIN	13	3.31	3.93	23	.93	24.73
ROYALE	14			8		
SIMMONS AIRLINES	11					
SOUTH PACIFIC ISLAND	35	.20	175.00	5	.39	12.82
SOUTHWEST	67	86.90	.77	63	76.69	.82
SUN AIRE	27			11		
TEXAS INT'L	147	43.44	3.38	252	39.71	6.35
THE FLYING TIGER LINE	13	3.81	3.41	2	3.65	.55
TRANSAMERICA	30	5.26	5.70	46	8.58	5.36
TWA	912	176.82	5.16	1187	182.67	6.50
UNITED	695	326.63	2.13	662	292.94	2.26
USAIR e/	331	167.78	1.97	464	161.69	2.87
WESTAIR COMMUTER	60	3.77	15.92	16		
WESTERN	195	96.29	2.03	183	93.36	1.96
WIEN AIR ALASKA	15	9.84	1.52	13	9.27	1.40
WINGS WEST	16			3		
WORLD	174	17.33	10.04	451	20.12	22.42
OTHER U.S. AIRLINES	314	35.61	8.82	687	47.66	14.41

FOREIGN AIRLINES........	FLIGHT PROBLEMS	OVER-SALES	RESERVATIONS AND TICKETING	FARES	REFUNDS	BAGGAGE	CUSTOMER SERVICE	SPECIAL PASSENGERS	SMOKING	ADVER-TISING	CREDIT	TOURS	OTHER	TOTAL
AER LINGUS	3	3	0	1	2	3	1	1	0	0	0	1	0	15
AEROMEXICO	14	15	3	0	3	17	10	0	2	0	0	0	5	69
AIR CANADA	1	0	0	0	7	2	3	0	2	0	0	0	0	15
AIR FRANCE	8	3	0	1	4	11	5	0	2	0	0	0	4	38
AIR INDIA	3	9	1	2	3	7	3	0	0	0	0	0	0	28
AIR JAMAICA	2	8	1	0	5	3	1	0	0	0	0	0	2	22
ALITALIA AIRLINES	4	10	2	3	8	10	4	0	2	0	0	0	2	45
ALIA JORDANIAN AIRLINES	0	1	0	0	2	11	0	0	1	0	0	0	1	16
AVIANCA	4	6	0	1	5	2	1	1	0	0	0	0	2	22
BAHAMASAIR	4	1	0	1	1	7	1	0	0	0	0	0	0	15
BRITISH AIRWAYS	12	15	8	4	3	18	9	0	3	1	0	0	1	74
BRITISH CALEDONIAN AIRWAY	2	2	3	2	0	0	3	0	2	0	0	0	0	14
BWIA	6	1	0	0	0	5	1	0	0	0	0	0	0	13
DOMINICANA DE AVIACION	1	5	0	0	0	5	1	0	0	0	0	0	1	13
EL AL ISRAEL	3	3	0	0	1	3	1	0	0	0	1	0	0	12
FAUCETT, S.A.	0	1	0	1	4	7	0	0	0	0	0	0	1	14
IBERIA AIRLINES	2	15	0	2	6	13	4	1	2	0	0	0	1	46
ICELANDAIR	1	7	0	1	1	2	0	0	0	1	0	0	0	13
KOREAN AIRLINES	1	2	2	1	3	7	3	0	0	0	0	1	3	23
KUWAIT AIRWAYS	2	1	3	0	0	7	4	0	0	0	0	0	0	17
KLM	3	7	7	3	5	10	3	0	2	0	0	0	3	43
LADECO AIRWAYS	0	0	1	0	24	0	0	0	0	0	0	0	2	27
LUFTHANSA	5	2	1	5	4	9	3	0	5	0	1	0	2	37
LACSA	0	3	1	0	2	8	0	0	0	0	0	0	0	14
MEXICANA	10	24	2	0	4	28	8	3	0	0	1	1	3	84
OLYMPIC AIRWAYS	4	3	3	2	3	5	4	0	0	0	0	0	0	24
PAKISTAN INTERNATIONAL	0	2	0	0	5	9	0	0	0	0	0	0	1	17
PHILIPPINE AIRLINES	0	1	0	1	2	5	0	0	0	0	0	0	2	11
ROYAL AIR MAROC	1	5	0	1	0	3	1	0	3	0	0	0	0	14
SAUDIA	8	0	2	0	2	7	1	0	3	0	0	0	0	23
SINGAPORE AIRLINES	0	3	0	0	3	3	0	0	0	0	0	0	1	10
SWISSAIR	1	2	0	2	0	1	2	0	0	0	0	0	3	11
SAHSA	1	0	0	0	1	4	3	0	0	0	0	0	1	10
SAS	2	4	2	2	0	1	1	0	2	0	0	0	0	14
VIASA	0	2	0	0	2	6	1	0	0	0	0	0	2	13
OTHER FOREIGN AIRLINES	25	24	9	5	29	52	9	1	3	0	0	4	15	176
1982 COMPLAINTS	113	190	51	41	144	291	91	7	34	2	3	7	58	1052
** PERCENTAGES **	12.6	18.1	4.8	3.9	13.7	27.7	8.7	.7	3.2	.2	.3	.7	5.5	100.0
1981 COMPLAINTS	260	255	79	94	161	486	160	4	39	13	0	6	88	1649
** PERCENTAGES **	15.8	15.5	4.8	5.7	9.8	29.5	9.7	.2	2.4	.8	.0	.4	5.3	100.0

CIVIL AERONAUTICS BOARD CONSUMER COMPLAINT REPORT
TWELVE MONTHS ENDING DECEMBER 1982

COMPLAINTS BY INDUSTRY GROUP	FLIGHT PROBLEMS	OVER-SALES	RESERVATIONS AND TICKETING	FARES	REFUNDS	BAGGAGE	CUSTOMER SERVICE	SPECIAL PASSENGERS	SMOKING	ADVER-TISING	CREDIT	TOURS	OTHER	TOTAL
U.S. AIRLINES..........														
1982 COMPLAINTS	2010	1296	459	531	878	1525	956	113	226	120	95	30	327	9566
1981 COMPLAINTS	2630	1292	599	557	931	2354	1319	123	313	114	103	38	454	10926
FOREIGN AIRLINES........														
1982 COMPLAINTS	133	190	51	41	144	291	91	7	34	2	3	7	58	1052
1981 COMPLAINTS	260	255	79	94	161	486	160	4	39	13	0	6	88	1645
CARGO/FREIGHT FORWARDERS														
1982 COMPLAINTS	0	0	0	1	0	1	0	0	0	1	0	0	37	40
1981 COMPLAINTS	0	0	0	0	1	0	0	0	0	0	0	0	104	105
TRAVEL AGENTS...........														
1982 COMPLAINTS	4	3	23	18	31	1	3	0	0	0	1	27	2	113
1981 COMPLAINTS	6	0	43	14	43	3	2	0	0	2	1	20	4	140
TOUR OPERATORS..........														
1982 COMPLAINTS	6	19	13	6	30	10	8	0	0	8	1	245	6	351
1981 COMPLAINTS	10	9	15	7	27	9	4	0	1	6	2	233	2	326
OTHER CARRIERS..........														
1982 COMPLAINTS	0	6	0	3	1	6	1	2	2	0	0	1	7	27
1981 COMPLAINTS	7	5	2	18	2	14	5	2	38	2	2	2	48	147
TOTAL COMPLAINTS........														
1982 COMPLAINTS	2153	1513	546	500	1384	1834	1059	122	262	131	100	310	437	10151
** PERCENTAGES **	21.2	14.9	5.4	5.9	13.7	18.1	10.4	1.2	2.6	1.3	1.0	3.1	4.3	100.0
1981 COMPLAINTS	2913	1560	737	799	1067	2866	1490	129	391	137	110	299	[illegible]	[illegible]
** PERCENTAGES **	22.1	11.9	5.6	6.0	9.1	21.7	11.3	1.0	3.0	1.0	.8	2.3	[illegible]	[illegible]

INFORMATION PLEASE ALMANAC

ATLAS & YEARBOOK

1985

38TH EDITION

HOUGHTON MIFFLIN COMPANY BOSTON

1985

Pollutant Standard Index (PSI) in Standard Metropolitan Statistical Cities—1980–1981

	1981				1980			
Metropolitan Area	0–99	100–199	200–300	More than 300	0–99	100–199	200–300	More than 300
Buffalo, N.Y.	358	6	—	1	348	12	6	—
Chicago, Ill.	347	18	—	—	318	45	3	—
Denver, Colo.	286	56	22	1	277	62	23	4
Houston, Texas	298	47	20	—	265	80	21	—
Kansas City, Mo.–Kan.	361	4	—	—	329	36	1	—
Los Angeles, Calif.	117	137	111	—	145	109	110	2
Louisville, Ky.–Ind.	345	19	1	—	307	56	3	—
Milwaukee, Wis.	354	10	1	—	350	14	2	—
New York, N.Y.–N.J.	259	102	4	—	235	129	2	—
Philadelphia, Pa.–N.J.	333	31	1	—	303	59	4	—
Portland, Oreg.–Wash.	335	26	4	—	311	42	10	4
Riverside, San Bernardino–Ontario, Calif.	181	92	92	—	195	78	92	1
St. Louis, Mo.–Ill.	339	23	2	1	311	49	6	—
Salt Lake City, Utah	335	29	1	—	312	36	18	—
San Diego, Calif.	296	67	2	—	n.a.	n.a.	n.a.	n.a.
Seattle–Everett, Wash.	330	34	1	—	333	33	—	—
Washington, D.C.–Md.–Va.	344	21	—	—	297	67	2	—

Source: U.S. Council on Environmental Quality, 1980 and unpublished data. PSI is a highly summarized health-related index based on the following criteria pollutants: Carbon monoxide, sulfur dioxide, total suspended particulates, photochemical oxidants or ozone, and nitrogen dioxide. The PSI for one day will rise above 100 when any one of the 5 criteria pollutants (at only one station in an SMSA) reaches a level judged to have adverse short-term effects on human health. Depending on the pollutant, the time to exceed the standard varies from 1 to 24 hours. The health effect labels for PSI intervals are good or moderate for 0–99; unhealthy for 100–199; very unhealthful for 200–300; and hazardous for more than 300.

Federal Outlays for the Environment by Activity, 1978–1982

(In millions of dollars, except percent, for years ending Sept. 30)

Activity	1982[1]	1981	1980	1979	1978
Pollution abatement and control	$6,954	$7,220	$7,632	$6,945	$5,934
Percent Environmental Protection Agency	68.6	72.8	73.4	69.1	68.6
Aid to State and local governments	4,500	4,671	5,177	4,769	3,972
Research and development	800	810	782	795	836
Standard setting and enforcement	750	776	791	537	524
Reduction of pollution from Federal facilities	506	488	471	550	431
Other	398	474	411	294	171
Protection and enhancement	2,266	2,583	2,749	2,614	2,688
Aid to State and local governments[3]	851	1,063	891	856	847
City recreation	196	209	335	338	425
Noncity general recreation	232	253	128	196	158
Historic preservation and rehabilitation	75	106	84	45	39
Direct Federal activities[3]	1,415	1,520	1,858	1,758	1,841
Noncity general recreation	310	319	468	449	372
Preservation and protection[4]	347	382	434	387	647
City recreation	213	206	212	196	132
Historic preservation and rehabilitation	101	100	112	133	63
Understanding, describing, and predicting[3]	2,603	2,698	2,376	2,423	2,155
Observation and prediction[5]	929	902	854	757	744
Locate and describe natural resources	739	902	650	861	688
Research on environmental impact on people	428	398	337	303	266
Ecological and other basic environmental research	181	178	228	266	242
Physical environmental surveys	302	292	281	214	197
Total	11,823	12,501	12,757	11,982	10,777

1. Estimated. Based on January budget estimates. 2. Includes funds for planning, monitoring and surveillance, and technical assistance. 3. Includes activities not shown separately. 4. Unique natural areas and endangered species. 5. Includes weather, ocean, and earthquakes and other disturbances. *Source: Statistical Abstract of the United States.* 1984.

Water Supply of the World[1]

The Antarctic Icecap is the largest supply of fresh water, nearly 2 percent of the world's total of fresh and salt water. As can be seen from the table below, the amount of water in our atmosphere is over ten times as large as the water in all the rivers taken together. The fresh water actually available for human use in lakes and rivers and the accessible ground water amounts to only about one third of one percent of the world's total water supply.

	Surface area (square miles)	Volume (cubic miles)	Percentage of total
Salt Water			
The oceans	139,500,000	317,000,000	97.2
Inland seas and saline lakes	270,000	25,000	0.008
Fresh Water			
Freshwater lakes	330,000	30,000	0.009
All rivers (average level)	—	300	0.0001
Antarctic Icecap	6,000,000	6,300,000	1.9
Arctic Icecap and glaciers	900,000	680,000	0.21
Water in the atmosphere	197,000,000	3,100	0.001
Ground water within half a mile from surface	—	1,000,000	0.31
Deep-lying ground water	—	1,000,000	0.31
Total (rounded)	—	326,000,000	100.00

1. All figures are estimated. *Source:* Department of the Interior, Geological Survey.

Speed of Animals

Most of the following measurements are for maximum speeds over approximate quarter-mile distances. Exceptions—which are included to give a wide range of animals—are the lion and elephant, whose speeds were clocked in the act of charging; the whippet, which was timed over a 200-yard course; the cheetah over a 100-yard distance; man for a 15-yard segment of a 100-yard run; and the black mamba, six-lined race runner, spider, giant tortoise, three-toed sloth, and garden snail, which were measured over various small distances.

Animal	Speed mph	Animal	Speed mph	Animal	Speed mph
Cheetah	70	Mongolian wild ass	40	Man	27.89
Pronghorn antelope	61	Greyhound	39.35	Elephant	25
Wildebeest	50	Whippet	35.5	Black mamba snake	20
Lion	50	Rabbit (domestic)	35	Six-line race runner	18
Thomson's gazelle	50	Mule deer	35	Squirrel	12
Quarter horse	47.5	Jackal	35	Pig (domestic)	11
Elk	45	Reindeer	32	Chicken	9
Cape hunting dog	45	Giraffe	32	Spider (Tegenearia atrica)	1.17
Coyote	43	White-tailed deer	30	Giant Tortoise	0.17
Gray fox	42	Wart hog	30	Three-toed sloth	0.15
Hyena	40	Grizzly bear	30	Garden snail	0.03
Zebra	40	Cat (domestic)	30		

Source: Natural History Magazine, March 1974, copyright 1974. The American Museum of Natural History; and James Doherty, Curator of Mammals, N.Y. Zoological Society.

Animal Names: Male, Female, and Young

Animal	Male	Female	Young	Animal	Male	Female	Young	Animal	Male	Female	Young
Ass	Jack	Jenny	Foal	Duck	Drake	Duck	Duckling	Sheep	Ram	Ewe	Lamb
Bear	Boar	Sow	Cub	Elephant	Bull	Cow	Calf	Swan	Cob	Pen	Cygnet
Cat	Tom	Queen	Kitten	Fox	Dog	Vixen	Cub	Swine	Boar	Sow	Piglet
Cattle	Bull	Cow	Calf	Goose	Gander	Goose	Gosling	Tiger	Tiger	Tigress	Cub
Chicken	Rooster	Hen	Chick	Horse	Stallion	Mare	Foal	Whale	Bull	Cow	Calf
Deer	Buck	Doe	Fawn	Lion	Lion	Lioness	Cub	Wolf	Dog	Bitch	Pup
Dog	Dog	Bitch	Pup	Rabbit	Buck	Doe	Bunny				

Source: James Doherty, Curator of Mammals, N.Y. Zoological Society.

Heat Wave in August 1983 Breaks the Record

According to the National Climate Analysis Center, the August 1983 heat wave was the hottest month on record for the United States and also one of the driest.

The unbroken heat wave lasted almost nine weeks, claiming at least 220 lives and destroying $10 billion in crops. The summer of 1983 was only the 17th hottest overall.

Household Appliance Data, November 1982

(million households)

Appliance	Census region: Northeast No.	North Central No.	South No.	West No.	Area type: Metropolitan No.	Non-metropolitan No.	Total No.	Total %
Electric Appliances								
Television set (color)	15.5	18.3	22.8	14.4	54.3	16.7	71.0	84.8
Television set (B/W)	8.9	10.6	13.7	5.8	29.6	9.3	38.9	46.5
Clothes washer (automatic)	11.9	14.5	20.2	11.4	42.4	15.5	57.9	69.1
Clothes washer (wringer)	0.5	1.0	0.9	0.1	1.5	1.0	2.5	3.0
Range (stove-top or burners)	7.6	11.9	16.5	8.7	31.8	12.9	44.7	53.3
Oven (not microwave)[1]	7.0	10.0	15.0	7.7	28.3	11.4	39.7	47.4
Microwave[1]	0.6	1.6	1.3	1.4	3.7	1.1	4.9	5.8
Clothes dryer	6.9	9.7	14.2	7.2	26.3	11.6	37.9	45.3
Separate freezer	5.0	9.1	12.0	4.9	19.9	11.1	31.0	37.0
Dishwasher	5.8	6.8	10.3	7.3	24.7	5.6	30.3	36.1
Humidifier	2.5	6.3	1.7	0.8	7.8	3.5	11.3	13.5
Dehumidifier	2.4	3.9	1.1	0.1	5.5	2.1	7.5	9.0
Window or ceiling fan	5.0	6.5	10.0	1.9	17.6	5.9	23.5	28.0
Whole house cooling fan	1.3	1.8	2.8	0.6	5.0	1.5	6.5	7.8
Evaporative cooler	—	0.1	0.6	2.8	3.0	0.6	3.6	4.2
Gas appliances								
Range (stove-top or burners)	10.3	9.6	11.4	7.7	31.5	7.6	39.0	46.6
Oven[1]	8.9	8.1	9.7	6.9	27.3	6.3	33.7	40.2
Clothes dryer	2.7	4.3	2.4	2.8	10.6	1.6	12.2	14.6
Outdoor piped gas grill	0.7	0.6	1.3	0.5	2.7	0.4	3.0	3.6
Outdoor LPG gas grill	2.4	1.5	1.8	0.7	4.9	1.5	6.4	7.7
Outdoor gas light	0.1	0.5	0.7	0.1	1.2	0.3	1.4	1.7
Swimming pool heater	—	0.1	—	0.1	0.3	—	0.3	0.4
Refrigerators								
One	15.2	17.6	25.1	14.5	54.6	17.8	72.4	86.4
Two or more	2.7	3.6	2.9	1.9	8.5	2.7	11.1	13.3
None	0.1	0.1	0.1	—	0.1	0.1	0.2	0.3
Air Conditioning (A/C)								
Central	2.1	5.9	11.8	3.5	19.2	4.1	23.3	27.8
Individual room units	7.2	6.4	9.5	2.2	19.3	6.0	25.3	30.2
None	8.6	9.0	6.8	10.7	24.7	10.4	35.1	41.9
Total households	18.0	21.3	28.1	16.5	63.2	20.6	83.8	100.0

1. Data are for the most used oven. NOTE: A dash represents less than 0.05 million households. NOTE: Sum of components may not equal total due to independent rounding. *Source:* Energy Information Administration, Form EIA-457, "The Residential Energy Consumption Survey."

can we get '92 figures?

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MPG	$1.60	$1.70
50	320	340
45	355	377
40	400	425
35	458	486
30	533	566
25	640	680
20	800	850
15	1,067	1,134
10	1,600	1,700

GREAT DISASTERS

(For later disasters, see Current Events of 1984)

Earthquakes and Volcanic Eruptions

A.D. 79 **Aug. 24, Italy:** eruption of Mt. Vesuvius buried cities of Pompeii and Herculaneum, killing thousands.

1556 **Jan. 24, Shaanxi (Shensi) Province, China:** most deadly earthquake in history; 830,000 killed.

1755 **Nov. 1, Portugal:** one of the most severe of recorded earthquakes leveled Lisbon and was felt as far away as southern France and North Africa; 10,000–20,000 killed in Lisbon.

1883 **Aug. 26–28, Netherlands Indies:** eruption of Krakatau; violent explosions destroyed two thirds of island. Sea waves occurred as far away as Cape Horn, and possibly England. Estimated 36,000 dead.

1902 **May 8, Martinique, West Indies:** Mt. Pelée erupted and wiped out city of St. Pierre; 40,000 dead.

1906 **April 18, San Francisco:** earthquake accompanied by fire razed more than 4 sq mi.; more than 500 dead or missing; property damage about $250–300 million.

1908 **Dec. 28, Messina, Sicily:** about 85,000 killed and city totally destroyed.

1915 **Jan. 13, Avezzano, Italy:** earthquake left 29,980 dead.

1920 **Dec. 16, Gansu (Kansu) Province, China:** earthquake killed 200,000.

1923 **Sept. 1, Japan:** earthquake destroyed third of Tokyo and most of Yokohama; more than 140,000 killed.

1933 **March 10, Long Beach, Calif.:** 117 left dead by earthquake.

1935 **May 31, India:** earthquake at Quetta killed an estimated 50,000.

1939 **Jan. 24, Chile:** earthquake razed 50,000 sq mi.; about 30,000 killed.

Dec. 27, Northern Turkey: severe quakes destroyed city of Erzingan; about 100,000 casualties.

1946 **April 1, Alaska, Hawaii, West Coast:** earthquake and tsunami (tidal wave) left 173 dead in Hawaii.

1950 **Aug. 15, India:** earthquake affected 30,000 sq mi. in Assam; 20,000–30,000 believed killed.

1963 **July 26, Skoplje, Yugoslavia:** four fifths of city destroyed; 1,011 dead, 3,350 injured.

1964 **March 27, Alaska:** strongest earthquake ever to strike North America hit 80 miles east of Anchorage; followed by seismic wave 50 feet high that traveled 8,445 miles at 450 miles per hour; 117 killed and damage in Alaska and West Coast $500–750 million.

1970 **May 31, Peru:** earthquake left 50,000 dead, 17,000 missing.

1971 **Feb. 9, Los Angeles:** earthquake rocked San Fernando Valley. Death toll 64; damage $1 billion.

1972 **April 10, Iran:** 5,000 killed in earthquake 600 miles south of Teheran.

Dec. 22, Managua, Nicaragua: earthquake devastated city, leaving up to 6,000 dead.

1976 **Feb. 4, Guatemala:** earthquake left over 23,000 dead.

July 28, Tangshan, China: earthquake devastated 20-sq-mi. area of city leaving estimated 242,000 dead.

Aug. 17, Mindanao, Philippines: earthquake and tidal wave left up to 8,000 dead or missing.

1977 **March 4, Bucharest:** earthquake razed most of downtown Bucharest; 1,541 reported dead, over 11,000 injured.

1978 **Sept. 16, Tabas, Iran:** earthquake destroyed city in eastern Iran, leaving 25,000 dead.

1980 **Nov. 23, Naples, Italy:** 2,735 killed when earthquake struck southern Italy.

1982 **Dec. 13, Yemen:** 2,800 reported dead in earthquake.

Floods, Avalanches, and Tidal Waves

1228 **Holland:** 100,000 persons reputedly drowned by sea flood in Friesland.

1642 **China:** rebels destroyed Kaifeng seawall; 300,000 drowned.

1889 **May 31, Johnstown, Pa.:** more than 2,200 died in flood.

1896 **June 15, Sanriku, Japan:** earthquake and tidal wave killed 27,000.

1928 **March 12, Santa Paula, Calif.:** collapse of St. Francis Dam left 450 dead.

1953 **Northwest Europe:** storm followed by floods devastated North Sea coastal areas. Netherlands was hardest hit with 1,794 dead.

1959 **Dec. 2, Frejus, France:** flood caused by collapse of Malpasset Dam left 412 dead.

1960 **Agadir, Morocco:** 10,000–12,000 dead as earthquake set off tidal wave and fire, destroying most of city.

1962 **Jan. 10, Peru:** avalanche down Huascaran, extinct Andean volcano, killed more than 3,000 persons.

1963 **Oct. 9, Italy:** landslide into the Vaiont Dam; flood killed about 2,000.

1966 **Oct. 21, Aberfan, Wales:** avalanche of coal, waste, mud, and rocks killed 144 persons, including 116 children in school.

1969 **Jan. 18–26, Southern California:** floods and mudslides from heavy rains caused widespread property damage; at least 100 dead. Another downpour (Feb. 23–26) caused further floods and mudslides; at least 18 dead.

1970 **Nov. 13, East Pakistan:** 200,000 killed by cyclone-driven tidal wave from Bay of Bengal. Over 100,000 missing.

1971 **Sept. 29, Orissa State, India:** cyclone and tidal wave off Bay of Bengal killed as many as 10,000.

1972 **Feb. 26, Man, W. Va.:** more than 118 died when slag-pile dam collapsed under pressure of torrential rains and flooded 17-mile valley.

June 9–10, Rapid City, S.D.: flash flood caused 237 deaths and $160 million in damage.

June 20, Eastern Seaboard: tropical storm Agnes, in 10-day rampage, caused widespread flash floods. Death toll was 129, 115,000 were left homeless, and damage estimated at $3.5 billion.

1976 **Aug. 1, Loveland, Colo.:** Flash flood along Route 34 in Big Thompson Canyon left 139 dead.

Comparison of Median Earnings of Year-Round, Full-Time Workers; 15 Years and Over, by Sex, 1960 to 1982

Year	Median earnings: Women	Median earnings: Men	Earnings gap in current dollars	Women's earnings as a percent of men's	Percent men's earnings exceeded women's	Earnings gap in constant 1982 dollars
1960	$3,257	$5,368	$2,111	60.7	64.8	$6,880
1965	3,828	6,388	2,560	60.0	66.9	7,832
1970	5,323	8,966	3,643	59.4	68.4	9,056
1974	6,970	11,889	4,919	58.6	70.6	9,628
1975	7,504	12,758	5,254	58.8	70.0	9,423
1976	8,099	13,455	5,356	60.2	66.1	9,082
1977	8,618	14,626	6,008	58.9	69.7	9,570
1978	9,350	15,730	6,380	59.4	68.2	9,439
1979	10,169	17,045	6,876	59.7	67.6	9,144
1980	11,197	18,612	7,415	60.2	66.2	8,686
1981	12,001	20,260	8,259	59.2	68.8	8,765
1982	13,014	21,077	8,063	61.7	62.0	8,063

Source: Department of Commerce, Bureau of the Census.

Composition of the Civilian Labor Force and Unemployment

Race, sex, and age	July 1983 Civilian labor force: Number (thousands)	Percent distribution	July 1983 Unemployed: Number (thousands)	Percent distribution	Rate	July 1982 Civilian labor force: Number (thousands)	Percent distribution	July 1982 Unemployed: Number (thousands)	Percent distribution	Rate
White	97,255	64.4	7,995	59.1	8.2	96,493	87.3	8,356	77.4	8.7
Men, 20 years and older	51,901	34.4	4,010	29.6	7.7	51,292	46.4	4,037	37.4	7.9
Women, 20 years and older	38,161	25.3	2,587	19.1	6.8	37,845	34.2	2,777	25.7	7.3
Teenagers, 16 to 19 years	7,193	4.8	1,398	10.3	19.4	7,356	6.7	1,542	14.3	21.0
Black and other	11,741	35.6	2,298	40.9	19.6	14,027	12.7	2,433	22.6	17.3
Men, 20 years and older	5,599	17.0	1,040	18.5	18.6	6,784	6.1	1,063	10.0	15.7
Women, 20 years and older	5,317	16.1	859	15.3	16.2	6,247	5.7	897	8.3	14.4
Teenagers, 16 to 19 years	825	2.5	399	7.1	48.4	997	0.9	473	4.4	47.4
All races										
Men, 20 years and older	57,500	51.4	5,050	48.2	8.8	58,076	52.5	5,100	47.3	8.8
Women, 20 years and older	43,478	41.4	3,446	34.4	7.9	44,092	40.0	3,674	34.1	8.3
Teenagers, 16 to 19 years	8,018	7.3	1,797	17.4	22.4	8,353	7.6	2,015	18.7	24.1
Total	108,996	100.0	10,293	100.0	9.4	110,520	100.0	10,789	100.0	9.8

NOTE: Totals may not add due to rounding. *Source:* Department of Labor, Bureau of Labor Statistics.

Advertising Expenditures by Medium

(in Millions)

Medium	1982 Amt.	1982 % of total	1981 Amt.	1981 % of total	1980 Amt.	1980 % of total	1975 Amt.	1975 % of total	1970 Amt.	1970 % of total	1960 Amt.	1960 % of total
Newspapers	$17.7	26.6	$16.5	27.3	$14.8	27.7	$8.2	29.5	$5.7	29.2	$3.7	31.0
Magazines	3.7	5.6	3.5	5.8	3.1	5.9	1.5	5.2	1.3	6.6	0.9	7.9
Business Papers	1.9	2.8	1.8	3.0	1.7	3.1	0.9	3.3	0.7	3.8	0.6	5.1
Radio	4.7	7.0	4.2	7.0	3.7	6.9	2.0	7.1	1.3	6.7	0.7	5.8
Television	14.3	21.5	12.7	21.0	11.4	21.2	5.3	18.9	3.6	18.4	1.6	13.3
Direct mail	10.3	15.5	8.9	14.7	7.6	14.2	4.1	14.8	2.8	14.1	1.8	15.3
Outdoor	0.7	1.1	0.7	1.2	0.6	1.1	0.3	1.2	0.2	1.2	0.2	1.7
Miscellaneous[2]	13.3	19.9	12.1	20.0	10.7	19.9	5.6	20.0	3.9	20.0	2.4	19.8
Total	66.6	100.0	60.4	100.0	53.6	100.0	27.9	100.0	19.5	100.0	11.9	100.0

1. Preliminary. 2. Includes regional farm papers. *Sources:* McCann-Erickson, Inc., and *Advertising Age.*

Leading Advertising Agencies in World Billings

(in millions of dollars)

Agency	1983	1982
Young & Rubicam	$2,761.4	$2,511.7
Ted Bates Worldwide	2,586.1	2,374.0
J. Walter Thompson Co.	2,524.1	2,315.2
Ogilvy & Mather	2,360.4	2,151.0
McCann-Erickson	1,993.1	1,841.4
BBDO International	1,949.0	1,605.5
Saatchi & Saatchi Compton	1,710.6	1,302.6
Leo Burnett Co.	1,485.3	1,487.4
Foote Cone & Belding	1,405.6	1,211.4
SSC&B: Lintas Worldwide	1,321.5	1,305.5

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Unemployment Rate, 1983

Race and age	Women[1]	Men[1]
All races:	9.2	9.9
16 to 19 years	21.3	23.3
20 years and over	8.1	8.9
White	7.9	8.8
16 to 19 years	18.3	20.2
20 years and over	6.9	7.9
Minority races:	17.0	18.5
16 to 19 years	44.6	44.9
20 years and over	15.2	16.5

1. Annual averages. *Source:* Department of Labor, Bureau of Labor Statistics.

Percent Unemployed in the Civilian Labor Force

Year	Percent Unemployed	Year	Percent Unemployed
1920	5.2	1972	5.6
1922	6.7	1974	5.6
1924	5.0	1976	7.7
1926	1.8	1978	6.0
1928	4.2	1979	5.8
1930	8.7	1980	7.1
1932	23.6	1981	7.6
1934	21.7	1982	9.7
1936	16.9	1983	9.6
1938	19.0	Jan.	10.4
1940	14.6	Feb.	10.4
1942	4.7	March	10.3
1944	1.2	April	10.2
1946	3.9	May	10.1
1948	3.8	June	10.0
1950	5.3	July	9.5
1952	3.0	Aug.	9.5
1954	5.5	Sept.	9.2
1956	4.1	Oct.	8.8
1958	6.8	Nov.	8.4
1960	5.5	Dec.	8.2
1962	5.5	1984	
1964	5.2	Jan.	8.0
1966	3.8	Feb.	7.8
1968	3.6	March	7.8
1970	4.9	April	7.8

NOTE: Estimates prior to 1940 are based on sources other than direct enumeration. *Source:* Department of Labor, Bureau of Labor Statistics.

Employment and Unemployment

(in millions of persons)

Category	1983	1980	1979	1975	1970	1959	1950	1945	1941	1932	1929
EMPLOYMENT STATUS[1]											
Total noninstitutional population	174.2	169.8	167.0	155.3	140.3	117.9	106.6	105.5	101.5	—	—
Total labor force	—	109.0	107.0	96.0	86.0	70.9	63.9	65.3	57.5	51.3	49.4
Percent of population	64.0	64.2	64.1	61.8	61.3	60.2	59.9	61.9	56.7	—	—
Civilian labor force	111.6	106.9	105.0	93.8	82.8	68.4	62.2	53.9	55.9	51.0	49.2
Employed	100.8	99.3	98.8	85.8	78.7	64.6	58.9	52.8	50.4	38.9	47.6
Agriculture	3.4	3.4	3.3	3.4	3.5	5.6	7.2	8.6	9.1	10.2	10.5
Nonagricultural industries	97.5	95.9	95.5	82.4	75.2	59.1	51.8	44.2	41.3	28.8	37.2
Unemployed	10.7	7.6	6.1	7.9	4.1	3.7	3.3	1.0	5.6	12.1	1.6
Percent of labor force	9.6	7.1	5.8	8.5	4.9	5.5	5.3	1.9	9.9	23.6	3.2
Not in labor force	62.7	60.8	59.9	59.4	54.3	47.0	42.8	40.2	44.0	—	—
INDUSTRY											
Total nonagricultural employment	90.1	90.4	89.8	76.9	70.9	53.3	45.2	40.4	36.5	23.6	31.3
Goods-producing industries	23.4	25.7	26.5	22.6	23.6	20.4	18.5	17.5	16.0	8.6	13.3
Mining	1.0	1.0	1.0	0.8	0.6	0.7	0.9	0.8	1.0	0.7	1.1
Construction	3.9	4.3	4.5	3.5	3.6	3.0	2.4	1.1	1.8	1.0	1.5
Manufacturing: Durable goods	10.8	12.2	12.8	10.7	11.2	9.4	8.1	9.1	7.0	—	—
Nondurable goods	7.7	8.1	8.3	7.6	8.2	7.3	7.1	6.5	6.2	—	—
Services-producing industries	66.7	64.7	63.4	54.3	47.3	32.9	26.7	22.9	20.6	15.0	18.0
Transportation and public utilities	5.0	5.1	5.1	4.5	4.5	4.0	4.0	3.9	3.3	2.8	3.9
Trade: Wholesale	5.3	5.3	5.1	4.4	4.0	3.1	2.6	1.9	2.0	—	—
Retail	15.5	15.0	15.0	12.6	11.0	8.0	6.8	5.4	5.3	—	—
Finance, insurance, and real estate	5.5	5.2	5.0	4.2	3.6	2.5	1.9	1.5	1.5	1.3	1.5
Services	19.7	17.9	17.9	13.9	11.5	7.1	5.4	4.2	3.9	2.9	3.4
Federal government	2.8	2.9	2.8	2.7	2.7	2.2	1.9	2.8	1.3	0.6	0.5
State and local government	13.1	13.4	13.2	11.9	9.8	5.9	4.1	3.1	3.3	2.7	2.5

1. For 1929–45, figures on employment status relate to persons 14 years and over; beginning in 1950, 16 years and over.
NOTE: Figures may not add to totals because of rounding. *Source:* Department of Labor, Bureau of Labor Statistics.

Expenditures for New Plant and Equipment[1]

(in millions of dollars)

Year	Manufacturing and mining	Transportation	All other[2]	Total
1950	$8,570	$2,380	$14,370	$25,320
1955	13,810	2,600	20,170	36,580
1960	17,650	3,190	27,800	48,630
1965	26,770	5,460	38,200	70,430
1970	39,010	6,950	59,650	105,610
1975	61,020	8,680	88,010	157,710
1978	89,930	10,680	130,630	231,240
1979	110,060	12,350	148,050	270,460
1980	129,320	12,090	154,220	295,630
1981	143,650	12,050	165,790	321,490
1982	135,130	11,950	169,360	316,430
1983	123,180	11,250	168,750	303,200
1984[3]	139,460	10,960	182,900	333,320

1. Data exclude agriculture. 2. Includes electric and gas utilities, trade, service, communications, construction, and finance. 3. Planned capital expenditures. NOTE: This series was revised in January 1984. *Source:* Department of Commerce, Bureau of Economic Analysis.

New Housing Starts[1] and Mobile Homes Shipped

(in thousands)

Year	No. of units started	Year	No. of units started	Year	Mobile homes shipped
1900	189	1965	1,510	1965	217
1910	387	1970	1,469	1970	401
1920	247	1975	1,171	1975	213
1925	937	1976	1,548	1976	246
1930	330	1977	2,002	1977	277
1935	221	1978	2,036	1978	275
1940	603	1979	1,760	1979	277
1945	326	1980	1,313	1980	222
1950	1,952	1981	1,100	1981	241
1955	1,646	1982	1,072	1982	240
1960[1]	1,296	1983	1,712	1983	296

1. Prior to 1960, starts limited to nonfarm housing; from 1960 on, figures include farm housing. *Sources:* Department of Commerce, Housing Construction Statistics, 1900–1965, and Construction Reports, Housing Starts, 1970–83, Manufactured Housing Institute, 1965–76; National Conference of States on Building Codes and Standards.

Shareholders in Public Corporations

Characteristic	1983	1980	1975	1970	1965	1959	1952
Individual shareholders (thousands)	42,360	30,200	25,270	30,850	20,120	12,490	6,490
Owners of shares listed on New York Stock Exchange (thousands)	26,029	23,804	17,950	18,290	12,430	8,510	n.a.
Adult shareowner incidence in population	1 in 4	1 in 5	1 in 6	1 in 4	1 in 6	1 in 8	1 in 16
Median household income	$33,200	$27,750	$19,000	$13,500	$9,500	$7,000	$7,100
Adult shareowners with household income: under $10,000 (thousands)	1,460	1,742	3,420	8,170	10,080	9,340	n.a.
$10,000 and over (thousands)	36,261	25,715	19,970	20,130	8,410	2,740	n.a.
Adult female shareowners (thousands)	20,385	13,696	11,750	14,290	9,430	6,350	3,140
Adult male shareowners (thousands)	19,226	14,196	11,630	14,340	9,060	5,740	3,210
Median age	45	46	53	48	49	49	51

NOTE: n.a. = not available. *Source:* New York Stock Exchange.

50 Most Active Stocks in 1983

Stock	Share volume	Stock	Share volume	Stock	Share volume
American Tel. & Tel.	420,502,900	Atlantic Richfield	97,006,700	Standard Oil (Indiana)	75,719,300
Int'l Business Machines	186,294,000	Sony Corp.	96,055,800	Morris (Philip)	75,504,200
Exxon Corp.	166,494,600	Diamond Shamrock	94,775,500	Pepsi Co, Inc.	73,962,900
Chrysler Corporation	158,081,300	Ford Motor	94,170,100	Halliburton Co.	73,520,700
Merrill Lynch	127,643,200	General Electric	93,151,700	Int'l Tel. & Tel.	70,926,300
General Motors	126,271,600	AMR Corp.	92,136,600	National Semiconductor	70,264,200
American Express	112,792,580	RCA Corp.	92,057,600	Boeing Co.	70,234,900
Pan American World Airways	112,434,100	Johnson & Johnson	88,146,900	Prime Computer	69,947,900
Schlumberger, N.V.	112,353,700	K mart Corp.	88,068,800	Phillips Petroleum	69,067,500
Citicorp	111,945,900	Dow Chemical	81,958,300	Unocal Corp.	68,431,800
Eastman Kodak	111,325,100	Phibro-Salomon	81,885,200	GTE Corp.	67,491,300
Tandy Corp.	109,085,600	Hewlett-Packard	79,972,200	Archer-Daniels-Midland	67,332,800
Sears, Roebuck	103,730,400	Federal Nat'l Mortgage	79,688,645	Amerada Hess	66,828,100
Mobil Corp.	102,291,000	Warner Communications	79,051,700	BankAmerica	64,709,700
Digital Equipment	101,313,900	Goodyear Tire	79,040,500	Xerox Corp.	64,368,400
Gulf Oil	98,481,300	Coleco Industries	76,203,600	American Motors	64,334,100
Superior Oil	97,404,800	Standard Oil Co. of Cal.	75,841,100		

Source: New York Stock Exchange.

50 Companies With Largest Number of Stockholders

Company	Stockholders	Company	Stockholders
American Tel. & Tel.	2,960,000	Middle South Utilities	218,000
General Motors	998,000	United States Steel	216,000
Exxon Corporation	890,000	Dominion Resources	213,000
International Business Machines	770,000	Niagara Mohawk Power	209,000
General Electric	501,000	Consolidated Edison	207,000
GTE Corporation	476,000	Ohio Edison	204,000
Imperial Chemical	366,000	Northeast Utilities	201,000
Texaco Inc.	354,000	Eastman Kodak	200,000
Sears, Roebuck	340,000	RCA Corporation	200,000
Southern Company	340,000	Atlantic Richfield	198,000
American Electric Power	338,000	Union Electric	193,000
Bell Canada Enterprises	304,000	Standard Oil (Indiana)	190,000
Commonwealth Edison	301,000	Consumers Power	189,000
Ford Motor	291,000	Occidental Petroleum	185,000
Philadelphia Electric	276,000	International Tel. & Tel.	181,000
Mobil Corp.	272,000	Long Island Lighting	180,000
Pacific Gas & Electric	268,000	Pennsylvania Power & Light	169,000
Detroit Edison	254,000	Chrysler Corporation	169,000
Gulf Oil	253,000	BankAmerica	161,000
British Petroleum	251,000	Southern California Edison	158,000
duPont de Nemours	246,000	Duquesne Light	144,000
Hitachi, Ltd.	240,000	Westinghouse Electric	144,000
Standard Oil of California	236,000	Dow Chemical	136,000
Public Service Electric & Gas	232,000	Cleveland Electric	132,000
Tenneco Inc.	224,000	Matsushita Electric	129,000

Note: As of early 1984. *Source:* New York Stock Exchange.

50 Leading Stocks in Market Value

Stock	Market value (millions)	Listed shares (millions)	Stock	Market value (millions)	Listed shares (millions)
International Business Machines	$74,013	604.8	Merck & Co.	6,861	75.9
American Telephone & Telegraph	57,371	936.7	Dow Chemical	6,819	205.9
Exxon Corp.	33,877	906.4	American Express	6,746	207.6
General Electric	27,139	462.9	Reynolds (R.J.) Inds.	6,359	104.7
General Motors	23,375	314.3	International Telephone & Telegraph	6,140	137.2
Standard Oil (Indiana)	15,407	304.3	Union Pacific	5,813	114.5
Schlumberger, N.V.	15,218	302.8	Bristol-Myers	5,761	135.9
Sears, Roebuck	13,367	361.3	Tenneco Inc.	5,716	139.4
Eastman Kodak	12,658	165.7	Sun Co.	5,698	130.2
duPont de Nemours	12,392	238.3	Pfizer Inc.	5,696	159.3
Shell Oil	12,370	309.3	Abbott Laboratories	5,615	124.1
Mobil Corp.	12,282	427.2	Unocal Corp.	5,493	173.7
Standard Oil of California	11,888	342.1	Standard Oil (Ohio)	5,443	121.6
Atlantic Richfield	10,719	247.8	Teledyne, Inc.	5,385	32.3
Hewlett-Packard	10,681	252.1	Phillips Petroleum	5,329	154.4
Texaco Inc.	9,875	274.3	Bell Canada Enterprises	5,295	196.1
Minnesota Mining & Manufacturing	9,735	118.0	Wal-Mart Stores	5,271	135.1
Procter & Gamble	9,545	167.8	Motorola, Inc.	5,215	38.3
Gulf Oil	9,139	211.9	Rockwell International	5,098	154.5
Morris (Philip)	9,048	126.1	Citicorp	5,081	136.9
Getty Oil	8,687	88.5	Texas Oil & Gas	5,010	104.9
American Home Products	8,373	168.7	Westinghouse Electric	4,932	90.1
GTE Corp.	8,131	185.9	Superior Oil	4,880	132.8
Johnson & Johnson	7,800	190.8	Halliburton Co.	4,785	118.5
Coca-Cola Co.	7,300	136.4	Total	$571,897	11,134.6
Ford Motor	7,066	166.3			

NOTE: As of Dec. 31, 1983. Of the 1,518 common stocks listed on the New York Stock Exchange at the end of 1983, the 50 issues with the largest market value totaled $572 billion, or 37% of the total value of common stocks listed. The five largest common issues were valued at $216 billion, or 16% of the total. *Source:* New York Stock Exchange.

Total Family Income

(figures in percent)

Income range	White 1982	White 1980	White 1970	White 1960	Black and other races 1982	Black and other races 1980	Black and other races 1970	Black and other races 1960
Families (thousands)[1]	53,407	52,710	46,535	41,123	7,987	7,599	5,413	4,333
Under $2,500	1.9	1.6	5.6	15.1	4.9	5.0	15.6	39.8
$2,500 to $7,499	7.1	8.6	25.8	52.9	21.0	22.5	41.4	48.9
$7,500 to $12,400	11.1	13.1	33.4	24.6	17.5	18.5	25.6	9.9
$12,500 to $14,999	5.9	6.8	11.5	3.3	6.2	7.4	6.5	0.9
$15,000 to $19,999	12.3	14.1	13.8	2.2	11.1	12.8	7.4	0.3
$20,000 to $24,999	12.6	14.2	4.9	0.9	10.7	10.6	2.1	0.3
$25,000 to $34,999	20.3	20.8	3.2	—	14.5	12.9	1.1	—
$35,000 to $49,999	16.9	13.6	1.2	1.1	9.6	7.6	0.3	—
$50,000 and over	11.9	7.2	0.6	—	4.6	2.8	0.1	—
Median income	$24,603	$21,904	$10,236	$5,835	$15,211	$13,843	$6,516	$3,230

1. As of March 1984. *Source:* Department of Commerce, Bureau of the Census.

Producer Price Indexes by Major Commodity Groups

(1967 - 100)

Commodity	1983	1980	1975	1970	1965	1960	1955
All commodities	303.1	268.8	174.9	110.4	96.6	94.9	87.8
Farm products	248.2	249.4	186.7	111.0	98.7	97.2	98.2
Processed foods	256.0	241.2	182.6	112.1	95.5	89.5	85.0
Textile products and apparel	204.9	183.5	137.9	107.1	99.8	99.5	98.7
Hides, skins, and leather products	271.4	248.9	148.5	110.3	94.3	90.8	77.3
Fuels and related products and power	665.9	574.0	245.1	106.2	95.5	96.1	91.2
Chemicals and allied products	292.9	260.3	181.3	102.2	99.0	101.8	98.5
Rubber and plastic products	243.4	217.4	150.2	108.3	95.9	103.1	102.4
Lumber and wood products	307.3	288.9	176.9	113.6	95.9	95.3	97.1
Pulp, paper, and allied products	297.7	249.2	170.4	108.2	96.2	98.1	87.8
Metals and metal products	307.1	286.4	185.6	116.6	96.4	92.4	82.1
Machinery and equipment	286.4	239.8	161.4	111.4	93.9	92.0	75.7
Furniture and household durables	213.9	187.7	139.7	107.5	96.9	99.0	93.3
Nonmetallic mineral products	325.3	283.0	174.0	112.9	97.5	97.2	87.5
Transportation equipment (Dec. 1968 - 100)	256.7	207.0	141.5	104.6	98.5	98.8	—
Miscellaneous products	289.5	258.8	147.7	109.9	95.9	93.0	86.5

Source: Department of Labor, Bureau of Labor Statistics.

Life Insurance in Force

(in millions of dollars)

As of Dec. 31	Ordinary	Group	Industrial	Credit	Total
1915	$16,650	$100	$4,279	—	$21,029
1930	78,756	9,801	17,693	73	106,413
1945	101,550	22,172	27,675	365	151,762
1950	149,071	47,793	33,415	3,844	234,168
1955	216,812	101,345	39,682	14,493	373,332
1960	341,881	175,903	39,563	29,101	586,448
1965	499,638	308,078	39,818	53,020	900,554
1970	734,730	551,357	38,644	77,392	1,402,123
1980	1,760,474	1,579,355	35,994	165,215	3,541,038
1981	1,978,080	1,888,612	34,547	162,356	4,063,595
1982	2,216,388	2,066,361	32,766	161,144	4,476,659
1983	2,544,275	2,219,573	31,354	170,659	4,965,861

Source: American Council of Life Insurance.

Farm Indexes

(1977 - 100)

Year	Prices paid by farmers[1]	Prices rec'd by farmers[2]	Ratio
1950	37	56	151
1955	40	51	128
1960	44	52	118
1965	47	54	115
1970	55	60	109
1975	89	101	113
1980	138	134	97
1981	150	139	93
1982	156	133	85

1. Commodities, interest, and taxes, and wage rates. 2. All crops and livestock. *Source:* Department of Agriculture, Statistical Reporting Service.

Terms on Conventional First Mortgages: All Major Types of Lenders

Type of homes and year	Contract rate (percent)	Fees and charges (percent)	Effective rate (percent)	Maturity (years)	Loan amount	Purchase price	Loan-to-price ratio (percent)
New homes: 1983	12.11	2.39	12.57	26.7	70.6	93.9	77.3
1982	14.49	2.96	15.14	27.5	69.5	94.1	76.6
1981	14.13	2.66	14.70	27.7	65.2	90.3	74.8
1980	12.25	2.09	12.65	28.2	59,200	83,400	73.2
1979	10.48	1.66	10.77	28.5	53,300	74,400	73.9
1975	8.75	1.54	—	26.8	33,300	44,600	76.1
1970	8.27	1.03	—	25.1	25,200	35,500	71.7
Existing homes: 1983	12.29	2.40	12.75	25.9	56.8	79.3	74.3
1982	14.78	2.55	15.33	24.9	48.7	70.7	71.9
1981	14.51	2.27	15.00	25.9	47.7	68.5	72.9
1980	12.58	1.90	12.95	26.8	48,000	68,000	73.3
1979	10.66	1.45	10.92	27.1	46,300	64,600	74.0
1975	9.01	1.19	—	24.0	27,400	38,200	73.4
1970	8.20	0.92	—	22.8	21,000	30,000	71.1

Source: Federal Home Loan Bank Board.

Consumer Credit

(non-installment credit; in millions of dollars)

End of year	Service credit	Charge accounts	Single-payment loans	Total credit outstanding	End of year	Service credit	Charge accounts	Single-payment loans	Total credit outstanding
1950	$ 1,638	$ 4,858	$ 3,642	$ 10,138	1975	12,027	11,739	27,378	51,144
1955	2,316	6,761	6,002	15,079	1980	19,280	13,135	42,352	74,767
1960[1]	3,734	7,235	9,084	20,053	1981	22,270	14,403	43,496	80,663
1965	5,545	8,319	15,462	29,326	1982	24,346	14,381	47,144	85,871
1970	9,106	9,156	19,323	37,585	1983	28,635	15,790	52,485	96,910

1. Beginning with 1960, data include Alaska and Hawaii. *Source:* Federal Reserve Board.

Estimated Annual Retail and Wholesale Sales by Kind of Business

(in millions of dollars)

Kind of business	1983	1980
Retail trade, total	$1,173,966	$951,902
Building materials, hardware, garden supply, and mobile home dealers	59,873	49,616
Automotive dealers	221,687	162,309
Furniture, home furnishings, and equipment stores	51,774	43,416
General merchandise group stores	142,997	117,227
Food stores	259,441	217,047
Gasoline service stations	103,121	93,624
Apparel and accessory stores	54,005	44,426
Eating and drinking places	115,710	85,842
Drug stores and proprietary stores	38,766	30,504
Liquor stores	19,690	17,083
Merchant wholesale trade, total	1,183,790	1,055,168
Total, (excluding farm-product raw materials)	(S)	932,941
Durable goods, total	504,810	448,040
Motor vehicles and automotive parts and supplies	98,814	84,227
Furniture and home furnishings	18,572	15,321
Lumber and other construction materials	(S)	34,514
Electrical goods	66,143	47,542
Hardware, plumbing, heating and supplies	31,187	27,136
Machinery, equipment, supplies	138,952	130,282
Scrap and waste materials	(S)	17,220
Nondurable goods, total	678,980	607,128
Total (excluding farm-product raw materials)	(S)	484,901
Paper and paper products	26,532	21,296
Drugs, drug proprietaries, and druggists' sundries	(S)	13,626
Apparel, piece goods, and notions	(S)	25,121
Groceries and related products	199,836	152,551
Beer, wine, distilled alcoholic beverages	36,945	32,554
Miscellaneous nondurable goods	84,744	68,382
Tobacco and tobacco products	(S)	11,366

NOTE: (S) = does not meet publication standards. *Source:* Department of Commerce, Bureau of the Census.

Per Capita Personal Income

Year	Amount	Year	Amount	Year	Amount	Year	Amount	Year	Amount
1929	$705	1960	$2,219	1966	$2,987	1972	$4,493	1978	$7,729
1935	474	1961	2,269	1967	3,167	1973	4,980	1979	8,638
1940	593	1962	2,373	1968	3,433	1974	5,428	1980	9,511
1945	1,223	1963	2,460	1969	3,667	1975	5,851	1981	10,517
1950	1,501	1964	2,592	1970	3,893	1976	6,402	1982	11,100
1955	1,881	1965	2,773	1971	4,132	1977	7,043	1983	11,675

Source: Department of Commerce, Bureau of Economic Analysis.

Median Earnings of Full-Time Women Workers
(persons 15 years and over)

Major occupation group	1982 earnings	As percent of men's earnings
Professional and technical workers	$18,423	65.9
Nonfarm managers and administrators	17,326	60.1
Clerical workers	12,693	61.9
Sales workers	11,002	50.2
Operatives (including transport)	11,369	79.6
Service workers (except private household)	8,565	59.2
All occupations	13,014	61.7

Source: U.S. Department of Commerce, Bureau of the Census.

Median Family Income
(in current dollars)

Year	Income	Percent change	Year	Income	Percent change
1960	$ 5,620	—	1978	$17,640	10.2
1970	9,867	—	1979	19,661	11.5
1972	11,116	—	1980	21,023	6.9
1973	12,051	8.4	1981	22,388	6.5
1974	12,902	7.1	1982	23,433	4.7
1975	13,719	6.3	1983	24,580	4.9

Source: Department of Commerce, Bureau of the Census. NOTE: Figures are latest available.

Median Weekly Earnings of Full-Time Workers by Occupation and Sex
(For third-quarter of 1983)

Occupation	MEN: Number of workers (in thousands)	MEN: Median weekly earnings	WOMEN: Number of workers (in thousands)	WOMEN: Median weekly earnings	TOTAL: Number of workers (in thousands)	TOTAL: Median weekly earnings
Managerial and professional specialty	10,204	$550	7,094	$363	17,298	$445
Executive, administrative, and managerial	5,407	568	2,746	347	8,153	476
Professional specialty	4,797	533	4,348	371	9,145	431
Technical, sales, and administrative support	8,372	402	14,014	247	22,386	287
Technicians and related support	1,472	444	1,228	304	2,700	367
Sales occupations	3,969	407	2,517	208	6,486	316
Administrative support, including clerical	2,931	370	10,269	248	13,200	266
Service occupations	3,945	258	3,849	176	7,793	208
Private household	13	(1)	288	112	302	113
Protective service	1,400	356	155	241	1,555	345
Service, except private household and protective	2,532	223	3,405	179	5,937	194
Precision production, craft, and repair	9,718	404	782	243	10,500	392
Mechanics and repairers	3,544	396	110	365	3,654	394
Construction trades	3,265	396	50	(1)	3,315	392
Other precision production, craft, and repair	2,909	417	622	237	3,531	390
Operators, fabricators, and laborers	10,349	316	3,523	207	13,873	279
Machine operators, assemblers, and inspectors	4,350	327	2,830	205	7,180	266
Transportation and material moving occupations	3,267	345	157	239	3,424	341
Handlers, equipment cleaners, helpers, and laborers	2,733	243	536	211	3,269	239
Fàrming, forestry, and fishing	1,324	198	215	175	1,539	194

1. Data not shown where base is less than 100,000. *Source:* U.S. Department of Labor, Bureau of Labor Statistics, "Employment and Earnings," January 1984.

Brief Explanation of the Consumer Price Index

The Consumer Price Index (CPI) is a measure of the average change in prices over time in a fixed market basket of goods and services. Effective with the January 1978 index, the Bureau of Labor Statistics began publishing CPI's for two population groups: (1) a new CPI for All Urban Consumers (CPI-U) which covers approximately 80% of the total noninstitutional civilian population; and (2) a revised CPI for Urban Wage Earners and Clerical Workers (CPI-W) which represents about half the population covered by the CPI-U. The CPI-U includes, in addition to wage earners and clerical workers, groups that historically have been excluded from CPI coverage, such as professional, managerial, and technical workers, the self-employed, short-term workers, the unemployed, and retirees and others not in the labor force.

The CPI is based on prices of food, clothing, shelter, and fuels, transportation fares, charges for doctors' and dentists' services, drugs, and the other goods and services that people buy for day-to-day living. Prices are collected in 85 urban areas across the country from about 18,000 tenants, 18,000 housing units for property taxes, and about 24,000 establishments—grocery and department stores, hospitals, filling stations, and other types of stores and service establishments. All taxes directly associated with the purchase and the use of items are included in the index. Prices of food, fuels, and a few other items are obtained every month in all 85 locations. Prices of most other commodities and services are collected every month in the five largest geographic areas and every other month in other areas. Prices of most goods and services are obtained by personal visits of the Bureau's trained representatives. Mail questionnaires are used to obtain public utility rates, some fuel prices, and certain other items.

In calculating the index, price changes for the various items in each location are averaged together with weights that represent their importance in the spending of the appropriate population group. Local data are then combined to obtain a U.S. city average. Separate indexes are also published by size of city, by region of the country, for cross-classification of regions and population-size classes, and for 28 local areas. Area indexes do not measure differences in the level of prices among cities; they measure only the average change in prices for each area since the base period.

The index measures price changes from a designated reference date—1967—which equals 100.0. An increase of 122%, for example, is shown as 222.0. This change can also be expressed in dollars as follows: The price of a base period "market basket" of goods and services in the CPI has risen from $10 in 1967 to $22.20.

Gross National Product or Expenditure
(in billions)

Item	1983	1982	1981	1980	1979	1978	1975	1970	1965	1960	1955	1950	1946	1938	1933	1929
Gross national product	$3,311	$3,073	$2,926	$2,626	$2,414	$2,128	$1,529	$982	$688	$506	$399	$286	$210	$85	$56	$103
GNP in constant (1972) dollars	1,538	1,485	1,510	1,481	1,483	1,399	1,202	1,075	926	737	655	534	477	312	222	315
Personal consumption expenditures	2,157	1,992	1,858	1,673	1,511	1,351	980	619	430	325	254	192	144	64	46	77
Durable goods	279	245	232	212	212	200	133	85	63	43	39	31	16	6	3	9
Nondurable goods	804	761	743	676	602	531	409	265	189	151	123	98	83	34	22	38
Services	1,074	986	883	785	696	620	438	269	179	131	92	63	45	24	20	30
Gross private domestic investment	471	414	451	395	416	352	189	141	112	76	68	54	31	6	1	16
Residential structures	131	91	106	105	119	108	52	36	31	24	24	20	7	2	1	4
Nonresidential structures	349	348	126	109	96	77	53	38	26	18	14	9	7	2	1	5
Producers' durable equipment	3.6	3.2	206	190	186	145	96	64	46	30	24	18	10	3	1	6
Change in business inventories	−8.7	−24.5	16	−6	18	22	−11	4	10	4	6	7	6	−1	−2	2
Net export of goods and services	−7.1	17.4	26	23	13	−10	20	4	8	4	2	2	8	1	(1)	1
Government purchases	690	649	591	535	474	436	339	219	138	100	75	38	28	13	8	8
Federal	690	649	230	199	168	153	123	96	67	54	44	19	18	5	2	1
National defense	275	259	154	132	111	99	84	74	49	44	38	14	15	n.a.	n.a.	n.a.
Other	200	179	76	67	57	54	39	22	18	9	6	5	3	n.a.	n.a.	n.a.
State and local	75	79	361	336	306	283	216	123	71	47	31	20	10	8	6	7
Implicit price deflator	391	415	194	177	163	150	127	91	74	69	61	54	44	27	25	33

1. Less than $500 million. NOTE: n.a. = not available. *Source:* Department of Commerce, Bureau of Economic Analysis.

money-market expert who popu-
yth stock" investment concept.
British novelist and playwright
ortraits with sharp and humor-
ones. Aug. 14, 1984.
best-selling historical novelist
e history and legends of ancient
"The King Must Die" and "The
." Dec. 13, 1983.
h, 80: renowned English actor-
er spanned more than 60 years.

, 82: a leading British actress,
de Dame Commander of Order
n 1960. July 7, 1984.
5: NBC News anchorwoman,
lt of a car accident. Oct. 24,

(Al), 91: major league player
n as Clown Prince of Baseball.

innovative American theatrical
Beckett, Albee, Pinter, Brecht,
njured in traffic accident. May

78: Russian author of "And
n" and other works that won
terature in 1965. Feb. 21,

er, 54: the younger sister of
, and Baptist evangelist and
ancer. Sept. 26, 1983.
Scottish-born conductor and
Baltimore Symphony and di-
onservatory. July 8, 1984.
62: president of Guinea and
t-ruling head of state. March

5: played key role in develop-
nd known as one of greatest
maticians. May 13, 1984.
outh African Prime Minister
o was a symbol of apartheid.

78: former head of U.S. dele-
ons. Represented U.S. at nu-
vith Soviet Union in Geneva
March 13, 1984.
94: co-founder and longtime
Digest whose philantropic
es of millions of dollars. May

uctor of choral and orches-
ast great conductors of Big
Waring Blendor. July 29,

): Olympic swimming cham-
Tarzan of the Jungle in a
20, 1984.
hor of popular short stories
kers set in her native Indi-

omposer, author of Broad-
n." June 15, 1984.
ctress for nearly a century
arances on stage, screen,
), 1984.
f Israel's war of independ-
Prime Minister in 1977–
st devoted to discovering
June 28, 1984.

BUSINESS & THE ECONOMY

Consumer Price Indexes

(1967 = 100)

Year	Commodities	Services	Housing	All items	Percent change[1]	Year	Commodities	Services	Housing	All items	Percent change[1]
1940	40.6	43.6	52.4	42.0	1.0	1975	158.4	166.6	166.8	161.2	8.9
1945	56.3	48.2	59.1	53.9	2.3	1977	174.7	194.3	186.5	181.5	6.5
1950	78.8	58.7	72.8	72.1	1.0	1979	208.4	234.2	227.6	217.4	11.3
1955	85.1	70.9	82.3	80.2	−0.4	1980	233.9	270.3	263.3	246.8	13.6
1960	91.5	83.5	90.2	88.7	1.6	1981	253.6	305.7	293.5	272.4	10.4
1965	95.7	92.2	94.9	94.5	1.7	1982	263.8	333.3	314.7	289.1	6.1
1970	113.5	121.6	118.9	116.3	5.9	1983	270.9	342.6	322.0	297.1	3.5

1. Over previous year. *Source:* Department of Labor, Bureau of Labor Statistics.

Consumer Price Index for All Urban Consumers

(1967 = 100)

Group	Feb. 1984	% increase Oct.–Feb.	Group	Feb. 1984	% increase Oct.–Feb.
All items	306.6	1.4	Fuel oil, coal, bottled gas	688.6	9.3
Food	302.1	3.1	House operation[1]	240.4	0.5
Alcoholic beverages	219.9	0.5	House furnishings	197.6	−0.2
Apparel and upkeep	196.2	−2.3	Transportation	305.8	0.0
Men's and boys' apparel	187.9	−2.2	Medical care	373.2	2.8
Women's and girls' apparel	159.0	−6.0	Personal care	267.9	1.8
Footwear	206.4	−1.1	Tobacco products	305.4	2.1
Housing, total	331.0	1.3	Entertainment	251.5	0.1
Rent	243.6	1.4	Personal and educational expenses	354.4	0.1
Gas and electricity	429.0	−1.5			

1. Combines house furnishings and operation. *Source:* Department of Labor, Bureau of Labor Statistics.

Consumer Price Index for Urban Wage Earners and Clerical Workers

(1967 = 100)

Effective January 1978, the Consumer Price Index was revised, with two indexes now being produced: A new index for All Urban Consumers covers 80% of the non-institutional population; the other index, the Consumer Price Index for Urban Wage Earners and Clerical Workers, covers about half of those included in the new index and is a major revision of the one that had been published for many years.

	1984[1]	1983	1980	1975	1970	1965	1960	1955	1950
All items	303.3	301.5	247.0	161.2	116.3	94.5	88.7	80.2	72.1
Food total	302.1	292.6	255.3	175.4	114.9	94.4	88.0	81.6	—
Apparel and upkeep	195.4	198.1	177.4	142.3	116.1	93.7	89.6	84.1	79.0
Housing total	324.2	324.2	263.2	166.8	118.9	94.9	90.2	82.3	72.8
Rent	242.9	241.3	191.3	137.3	110.1	96.9	91.7	84.3	70.4
Gas and electricity	427.9	426.7	301.2	169.6	107.3	99.4	98.6	87.5	81.2
Fuel oil, coal, bottled gas	691.4	626.4	557.2	253.3	110.1	94.6	89.2	82.3	72.7
House operation[2]	237.4	237.3	202.9	158.1	113.4	95.3	93.8	89.9	—
House furnishings	196.0	196.9	172.6	144.4	111.4	97.1	99.3	99.2	95.5
Transportation	307.7	308.2	250.5	150.6	112.7	95.9	89.6	77.4	68.2
Medical care	371.3	364.3	267.2	168.6	120.6	89.5	79.1	64.8	53.7
Personal care	266.1	264.4	212.7	150.7	113.2	95.2	90.1	77.9	68.3
Entertainment	247.7	245.8	203.7	144.4	113.4	95.9	87.3	76.7	74.4

1. May 1984. 2. Combines house furnishings and operation. *Source:* Department of Labor, Bureau of Labor Statistics.

No. 702. Relation of GNP, Net National Product, National Income, Personal Income, Disposable Personal Income, and Personal Saving: 1970 to 1989

[In billions of dollars. For definitions, see text, section 14]

ITEM	1970	1975	1980	1984	1985	1986	1987	1988	1989
Gross national product	1,015.5	1,598.4	2,732.0	3,772.2	4,014.9	4,231.6	4,515.6	4,873.7	5,200.8
Less: Capital consumption allowances [1]	88.8	161.8	303.8	415.5	437.2	460.1	487.0	514.3	554.4
Equals: Net national product [2]	926.6	1,436.6	2,428.1	3,356.8	3,577.6	3,771.5	4,028.6	4,359.4	4,646.4
Less: Indirect business tax and nontax liability	94.0	140.0	213.3	313.9	333.6	348.9	367.8	388.7	414.0
Plus: Subsidies [3]	2.9	2.4	5.7	9.9	7.2	12.8	17.4	16.2	6.3
Equals: National income [2]	832.6	1,289.1	2,203.5	3,028.6	3,234.0	3,412.6	3,660.3	3,984.9	4,223.3
Less: Corporate profits [4]	74.7	117.6	177.2	266.9	282.3	282.1	308.3	337.6	311.6
Net interest	41.2	83.8	200.9	304.8	319.0	325.5	328.6	371.8	445.1
Contributions for social insurance	62.2	118.5	216.5	324.9	354.1	379.2	400.1	442.6	476.8
Plus: Government transfer payments to persons	81.8	185.7	312.6	437.9	467.8	496.8	521.3	557.4	604.5
Personal interest income	69.3	122.5	271.9	444.7	478.0	493.2	501.3	547.9	643.2
Personal dividend income	22.2	28.7	52.9	75.5	78.7	85.8	91.8	102.2	114.4
Business transfer payments	4.1	7.4	12.1	18.7	22.0	24.6	28.5	30.3	32.4
Equals: Personal income	831.8	1,313.4	2,258.5	3,108.7	3,325.3	3,526.2	3,766.4	4,070.8	4,384.3
Less: Personal tax and nontax payments	116.2	170.6	340.5	440.2	486.6	512.9	571.6	591.6	658.8
Equals: Disposable personal income	715.6	1,142.8	1,918.0	2,668.6	2,838.7	3,013.3	3,194.7	3,479.2	3,725.5
Less: Personal outlays	657.9	1,038.2	1,781.1	2,504.5	2,713.3	2,888.5	3,102.2	3,333.6	3,553.7
Equals: Personal saving	57.7	104.6	136.9	164.1	125.4	124.9	92.5	145.6	171.8

[1] With capital consumption adjustment. [2] Includes items not shown separately. [3] Less current surplus of government enterprises. [4] With inventory valuation and capital consumption adjustments.

Source: U.S. Bureau of Economic Analysis, *The National Income and Product Accounts of the United States, 1929-82,* and *Survey of Current Business,* July issues.

No. 703. Selected Per Capita Income and Product Items: 1929 to 1989

[Based on Bureau of the Census estimated population including Armed Forces abroad; based on quarterly averages. Prior to 1960, excludes Alaska and Hawaii]

YEAR	CURRENT DOLLARS				CONSTANT (1982) DOLLARS		
	Gross national product	Personal income	Disposable personal income	Personal consumption expenditures	Gross national product	Disposable personal income	Personal consumption expenditures
1929	853	692	671	634	5,822	4,091	3,868
1930	740	613	593	568	5,218	3,727	3,569
1935	572	469	455	438	4,555	3,359	3,236
1940	760	587	568	538	5,850	4,017	3,804
1945	1,525	1,215	1,066	855	9,682	5,285	4,236
1950	1,900	1,504	1,368	1,267	7,935	5,220	4,834
1955	2,456	1,901	1,687	1,560	9,045	5,714	5,287
1960	2,851	2,265	1,986	1,829	9,213	6,036	5,561
1965	3,628	2,840	2,505	2,268	10,741	7,027	6,362
1970	4,951	4,056	3,489	3,121	11,781	8,134	7,275
1971	5,309	4,305	3,740	3,330	11,964	8,322	7,409
1972	5,777	4,676	4,000	3,609	12,426	8,562	7,726
1973	6,414	5,198	4,481	3,950	12,948	9,042	7,972
1974	6,886	5,657	4,855	4,285	12,760	8,867	7,826
1975	7,401	6,081	5,291	4,689	12,478	8,944	7,926
1976	8,175	6,655	5,744	5,178	12,961	9,175	8,272
1977	9,036	7,297	6,262	5,707	13,431	9,381	8,551
1978	10,105	8,141	6,968	6,304	13,993	9,735	8,808
1979	11,142	9,036	7,682	6,960	14,182	9,829	8,904
1980	11,995	9,916	8,421	7,607	13,994	9,722	8,783
1981	13,262	10,952	9,243	8,320	14,114	9,769	8,794
1982	13,614	11,485	9,724	8,818	13,614	9,725	8,818
1983	14,503	12,088	10,340	9,516	13,964	9,930	9,139
1984	15,913	13,114	11,257	10,253	14,771	10,419	9,489
1985	16,776	13,895	11,861	10,985	15,121	10,625	9,840
1986	17,511	14,592	12,469	11,576	15,385	10,905	10,123
1987	18,508	15,437	13,094	12,334	15,761	10,946	10,311
1988	19,783	16,524	14,123	13,144	16,305	11,368	10,580
1989	20,903	17,621	14,973	13,866	16,550	11,531	10,678

Source: U.S. Bureau of Economic Analysis, *The National Income and Product Accounts of the United States, 1929-82,* and *Survey of Current Business,* July issues.

No. 708. Personal Income and Its Disposition: 1970 to 1989

[In billions of dollars, except percent. For definition of personal income, see text, section 14]

ITEM	1970	1980	1984	1985	1986	1987	1988	1989
Personal income	**831.8**	**2,258.5**	**3,108.7**	**3,325.3**	**3,526.2**	**3,766.4**	**4,070.8**	**4,384.3**
Wage and salary disbursements	551.5	1,372.0	1,838.6	1,975.4	2,094.8	2,249.7	2,431.1	2,573.2
Commodity-producing industries [1]	203.7	470.7	577.6	608.9	625.6	649.9	696.4	720.6
Manufacturing	158.4	355.6	439.1	460.9	473.2	490.3	524.0	541.8
Distributive industries [2]	131.2	335.5	442.8	473.2	498.8	531.8	572.0	604.7
Service industries [3]	99.4	305.6	472.1	521.3	576.7	648.5	716.2	771.4
Government and gov't enterprises	117.1	260.2	346.1	372.0	393.7	419.4	446.6	476.6
Other labor income	32.5	138.4	182.9	187.6	199.3	209.4	225.5	241.9
Proprietors' income [4]	80.2	180.7	234.5	255.9	282.0	323.4	354.2	379.3
Rental income of persons [5]	18.2	6.6	8.5	9.2	11.6	13.7	16.3	8.2
Personal dividend income	22.2	52.9	75.5	78.7	85.8	91.8	102.2	114.4
Personal interest income	69.3	271.9	444.7	478.0	493.2	501.3	547.9	643.2
Transfer payments	85.9	324.7	456.6	489.8	521.5	549.9	587.7	636.9
Old-age, survivors, disability, and health insurance benefits	38.5	154.2	235.7	253.4	269.2	282.9	300.5	325.3
Gov't unemployment insurance benefits	4.0	16.1	15.8	15.7	16.3	14.5	13.4	14.7
Veterans benefits	7.7	15.0	16.4	16.7	16.7	16.6	16.9	17.3
Gov't employees retirement benefits	10.2	43.0	61.4	66.8	70.9	76.2	84.0	90.1
Other transfer payments	25.6	96.4	127.3	137.3	148.3	159.7	172.9	189.5
Less: Personal contributions for social insurance	27.9	88.6	132.7	149.3	161.9	172.9	194.1	212.8
Less: Personal tax and nontax payments.	*116.2*	*340.5*	*440.2*	*486.6*	*512.9*	*571.6*	*591.6*	*658.8*
Equals: Disposable personal income	**715.6**	**1,918.0**	**2,668.6**	**2,838.7**	**3,013.3**	**3,194.7**	**3,479.2**	**3,725.5**
Less: Personal outlays	*657.9*	*1,781.1*	*2,504.5*	*2,713.3*	*2,888.5*	*3,102.2*	*3,333.6*	*3,553.7*
Personal consumption expenditures	640.0	1,732.6	2,430.5	2,629.0	2,797.4	3,009.4	3,238.2	3,450.1
Interest paid by consumers to business	16.7	47.4	72.5	82.6	89.1	90.7	93.6	102.2
Personal transfer payments to foreigners (net)	1.2	1.1	1.5	1.7	1.9	2.2	1.9	1.4
Equals: Personal saving	**57.7**	**136.9**	**164.1**	**125.4**	**124.9**	**92.5**	**145.6**	**171.8**
Percent of disposable personal income	8.1	7.1	6.1	4.4	4.1	2.9	4.2	4.6
Real disposable personal income [6]	1,668.1	2,214.3	2,469.8	2,542.8	2,635.3	2,670.7	2,800.5	2,869.0
Average annual percent change [7]	4.1	2.9	2.8	3.0	3.6	1.3	4.9	2.4
PERCENT DISTRIBUTION								
Personal income	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**
Wage and salary disbursements	66.3	60.7	59.1	59.4	59.4	59.7	59.7	58.7
Other labor income	3.9	6.1	5.9	5.6	5.7	5.6	5.5	5.5
Proprietors' income [4]	9.6	8.0	7.5	7.7	8.0	8.6	8.7	8.7
Rental income of persons [5]	2.2	0.3	0.3	0.3	0.3	0.4	0.4	0.2
Personal dividend income	2.7	2.3	2.4	2.4	2.4	2.4	2.5	2.6
Personal interest income	8.3	12.0	14.3	14.4	14.0	13.3	13.5	14.7
Transfer payments	10.3	14.4	14.7	14.7	14.8	14.6	14.4	14.5
Less: Personal contributions for social insurance	-3.4	-3.9	-4.3	-4.5	-4.6	-4.6	-4.8	-4.9

[1] Comprises agriculture, forestry, fisheries, mining, construction, and manufacturing. [2] Comprises transportation; communication; electric, gas and sanitary services; and trade. [3] Comprises finance, insurance, and real estate; services; and rest of world. [4] With capital consumption and inventory valuation adjustments. [5] With capital consumption adjustment. [6] 1982 dollars. [7] Represents average for period of intervals shown here; for 1970, change from 1965. For explanation of average annual percent change, see Guide to Tabular Presentation.

Source: U.S. Bureau of Economic Analysis, *The National Income and Product Accounts of the United States, 1929-82,* and *Survey of Current Business,* July issues.

No. 709. Gross Saving and Investment: 1970 to 1989

[In billions of dollars]

ITEM	1970	1980	1982	1983	1984	1985	1986	1987	1988	1989
Gross saving	**154.7**	**445.0**	**446.4**	**463.6**	**568.5**	**533.5**	**525.3**	**555.5**	**656.1**	**691.5**
Gross private saving	164.5	478.4	557.1	592.2	673.5	665.3	669.5	662.6	751.3	779.3
Personal saving	57.7	136.9	153.9	130.6	164.1	125.4	124.9	92.5	145.6	171.8
Undistributed corporate profits [1]	17.9	37.7	20.0	65.0	94.0	102.6	84.5	83.2	91.4	53.0
Undistributed profits	19.2	97.6	39.6	58.9	67.0	44.6	24.0	50.2	70.5	49.1
Inventory valuation adjustment	-6.6	-43.1	-10.4	-10.9	-5.8	-1.7	6.7	-19.4	-27.0	-21.7
Capital consumption adjustment	5.2	-16.8	-9.2	17.0	32.7	59.7	53.8	52.4	47.8	25.5
Corporate CCA [2]	52.0	181.4	235.0	242.7	254.5	268.6	285.9	303.2	322.1	346.4
Noncorporate CCA [2]	36.9	122.4	148.2	153.9	160.9	168.7	174.2	183.8	192.2	208.0
Government surplus or deficit (-) [3]	-10.6	-34.5	-110.8	-128.6	-105.0	-131.8	-144.1	-107.1	-95.3	-87.8
Federal	-12.4	-61.3	-145.9	-176.0	-169.6	-196.9	-206.9	-158.2	-141.7	-134.3
State and local	1.8	26.8	35.1	47.5	64.6	65.1	62.8	51.0	46.5	46.4
Capital grants received by the U.S. (net)	0.9	1.2	-	-	-	-	-	-	-	-
Gross investment	**153.6**	**450.0**	**446.3**	**468.8**	**573.9**	**528.7**	**523.6**	**544.9**	**627.8**	**674.4**
Gross private domestic investment	148.8	437.0	447.3	502.3	664.8	643.1	659.4	699.5	747.1	771.2
Net foreign investment	4.8	13.0	-1.0	-33.5	-90.9	-114.4	-135.8	-154.6	-119.2	-96.8
Statistical discrepancy	**-1.1**	**4.9**	**-0.1**	**5.2**	**5.4**	**-4.8**	**-1.8**	**-10.6**	**-28.2**	**-17.0**

- Represents or rounds to zero. [1] With inventory valuation and capital consumption adjustments. [2] Capital consumption allowances with capital consumption adjustment. [3] National income and product accounts basis.

Source: U.S. Bureau of Economic Analysis, *The National Income and Product Accounts of the United States, 1929-82,* and *Survey of Current Business,* July issues.

[In millions of dollars, excep
annual percen

DIVISION AND STATE

United States
New England
Maine
New Hampshire
Vermont
Massachusetts
Rhode Island
Connecticut
Middle Atlantic
New York
New Jersey
Pennsylvania
East North Central
Ohio
Indiana
Illinois
Michigan
Wisconsin
West North Central
Minnesota
Iowa
Missouri
North Dakota
South Dakota
Nebraska
Kansas
South Atlantic
Delaware
Maryland
District of Columbia
Virginia
West Virginia
North Carolina
South Carolina
Georgia
Florida
East South Central
Kentucky
Tennessee
Alabama
Mississippi
West South Central
Arkansas
Louisiana
Oklahoma
Texas
Mountain
Montana
Idaho
Wyoming
Colorado
New Mexico
Arizona
Utah
Nevada
Pacific
Washington
Oregon
California
Alaska
Hawaii

Source: U.S. Bureau

At *OMNI*, we spend a good deal of time looking at science, technology, and the future, encountering far more ideas, innovations, and insights than we could ever cover in the pages of a monthly magazine. In discussions with scientists and leaders of technology, wide reading, reflection, and conversations among ourselves, we arrived at this month's cover story—a casserole, if you will, of items we feel are interesting, imaginative, and important. Some we've covered in *OMNI* before; others may be new to you. Some are old; others lie on the cutting edge of speculation. If you'd like to see us cover any of these items in greater depth, please drop us a line.

BEGINNINGS

1

SCIENCE is the orderly arrangement of knowledge about the universe and its workings, derived from careful observation, recording, analysis, and repeated testing of conclusions.

2

TECHNOLOGY is science put to practical use.

3

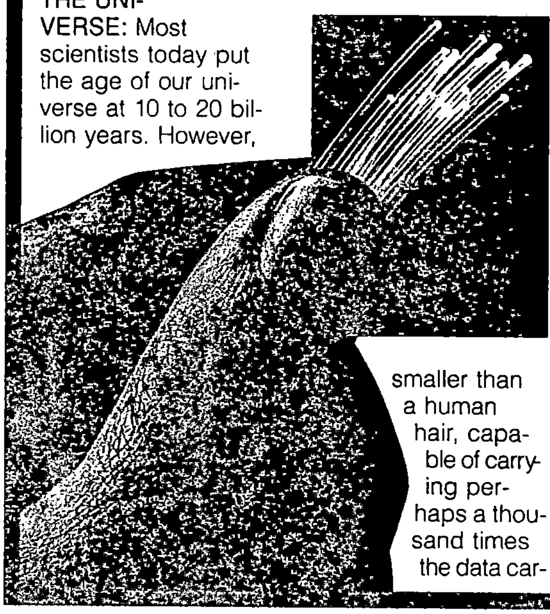
THE AGE OF THE UNIVERSE: Most scientists today put the age of our universe at 10 to 20 billion years. However, some scientists split the difference and say the universe is 15 billion years old, based on evidence and research as well as supposition.

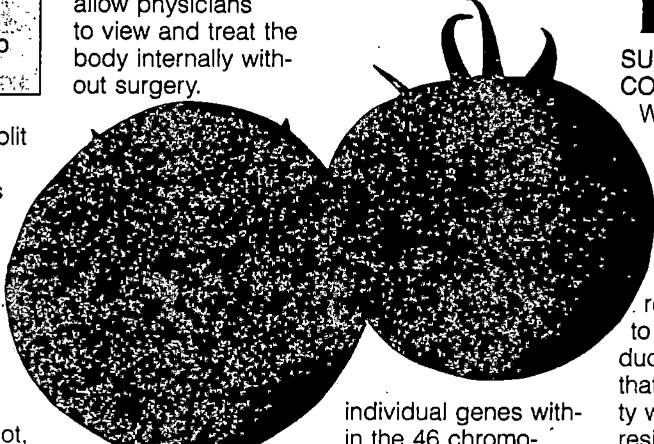
4

ASTROLOGY: is not, and never has been, a science.

5

FIBER OPTICS: More than 20 years ago, Corning Glass Works introduced optical fibers—glass threads, smaller than a human hair, capable of carrying perhaps a thousand times the data carried through a traditional copper-cable telephone wire. Over the next few decades, as phone companies replace copper wire with fiber-optic cable, they will be able to offer film libraries and interactive information services. Fiber-optic technologies are revolutionizing medicine. Fiber-optic instruments, for instance, allow physicians to view and treat the body internally without surgery.





6

TOP TOMATO: Athanasios Theologis and colleagues at the Plant Gene Expression Center in Albany, California, have built a top tomato: Their new plants, produced via genetic engineering, take more than twice as long to ripen as ordinary tomatoes. As a result, the tomatoes will stay fresh on long journeys across the country or even around the world.

7

NANOTECHNOLOGY TAKES JAPAN: The Japanese have a new rage: nanotechnology, where technology is built from molecular parts. Building machines that have working parts the size of molecules, scientists will eventually create ultrafast computers or tiny machines that can enter the body and deliver drugs or perform precise surgical functions.

8

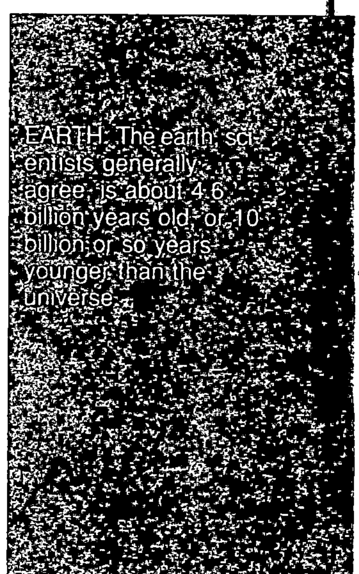
HUMAN GENOME PROJECT: The mammoth effort to identify and map the 100,000 individual genes within the 46 chromosomes of the human body. Taking some $3 billion and 15 years to complete, the government-sponsored project may prove even more ambitious—and fruitful. Knowing the sequence of the 3 billion base pairs of the human genome DNA that contain our genetic heritage may one day allow researchers to diagnose and treat inherited disorders as well as currently incurable diseases such as cancer and AIDS.

9

PHARMACOWLOGY: We may soon be using bovine factories to manufacture drugs. Researchers from Britain's Agricultural and Food Research Council, and a company called Pharmaceutical Proteins, have shown that cows endowed with foreign genes can manufacture pharmaceuticals in their milk. When bovine drug "pharms" are working full force, they'll eliminate the need for expensive drug factories. What's more, the genetically engineered cows will reproduce themselves with each new generation.

10

SUPERCONDUCTIVITY: What do high-speed computers and super-efficient power generation have in common? They are tantalizing products promised by researchers working to develop superconductors—materials that conduct electricity with almost no resistance and little loss of power. Until recently, the best superconductors required extremely cold temperatures. The discovery of high-temperature, ceramic-based superconductors in 1986, however, made the early promise of superconductivity a real possibility for these and many other applications.



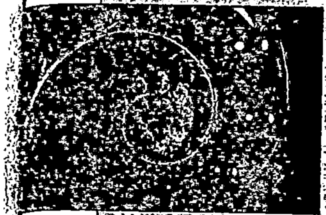
EARTH: The earth, scientists generally agree, is about 4.6 billion years old—or 10 billion or so years younger than the universe.

51 THINGS YOU MUST KNOW ABOUT SCIENCE, TECHNOLOGY, AND YOUR FUTURE

ARTICLE BY THE OMNI STAFF

12

CHAOS: Chaos challenges the deterministic notion, the bedrock of Western science, that one can predict future events by gathering enough information. Chaotic systems, however, appear to have an underlying, unexpected order; when plotted graphically, they yield elegant geometric patterns. Scientists have taken



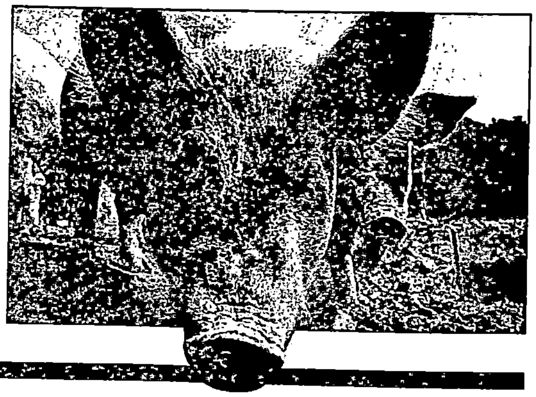
to the task of finding order in dynamic systems once believed to be random.

13

THE GENE RACE: On June 20, 1991, the National Institutes of Health presented biologist Craig Venter's voluminous application to the U.S. Patent Office. Venter's mission: patenting some 348 new human genes. As we usher in the new year, the U.S. Patent Office is holding its breath, expecting a gold gene rush of scientists arriving to patent every manner of human gene. But Maynard Olson, a Washington University geneticist and member of the Human Genome Project's advisory panel, thinks patenting human DNA is a philosophically iffy idea. "It's like patenting the periodic table," he says. Naked DNA sequences belong to all.

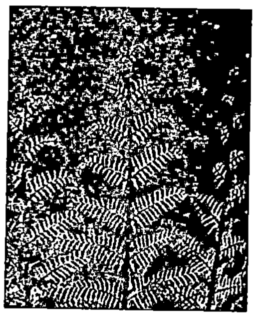
14

EARTHQUAKE PROTECTION: Using "smart" technology, future builders will fashion structures able to shake off earthquakes by incorporating massive weights or braces that counteract the oscillations. Sensors will transmit information about seismic vibrations to a central computer that will tell the weights how to respond in order to stabilize the building. Before such buildings become commonplace, however, the world may experience disastrous tremors—some in our own backyards. An earthquake of magnitude 6 on the Richter scale, similar to the San Francisco quake of 1989, is likely to strike along the Midwest's New Madrid fault—site of a series of severe quakes in 1811—by the year 2000.



15

RAIN FOREST, INC.: When it comes to saving the rain forest, multinational corporations are getting into the act. The giant pharmaceutical firm Merck & Company has decided to collaborate with scientists from Cornell University to collect samples of plant and invertebrate species in the Costa Rican forest. The hope is that some of the species will be used to make new drugs. Profits from the drugs, in turn, will be poured back into a fund for saving the rain forest.



WORRIES

16

DIET FOR A SMALL PLANET: As humans take up more and more space on the planet, we may have to come up with alternate ways of producing our food. One possible solution was recently suggested by an expert panel of the National Research Council. Instead of full-sized livestock, the panel suggested, we should turn to "microlivestock"—miniature versions of cattle, sheep, goats, and pigs, and other diminutive species, including the giant rat. "Like computers, livestock for use in developing countries should be getting smaller and becoming more 'personal,'" the NRC report said. "Conventional 'mainframes' such as cattle are too large for the world's poorest people; they require too much space and expense."

17

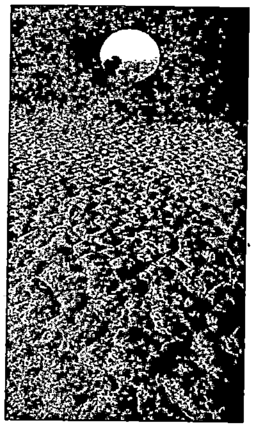
BIODIVERSITY: Scattered among hundreds of thousands of plant species lies a wealth of genetic information. Many of the species have never even been identified, much less studied. Most of them never will be. Selective breeding practices of modern agriculture and widespread deforestation are killing them off at breakneck speed. With each dies a library of genetic information, possibly including the clues to kicking cancer or feeding a hungry world.

18

LEAD ON ICE: Greenland's ice serves as an invaluable monitor of lead pollution. Two decades ago, scientists found that lead concentration in Greenland's ice had increased about 200-fold since ancient times. The pollution reflected the emissions of lead-based gasoline. Based in part on this research, governmental bodies around the world began limiting the amount of lead added to fuel. It may work: In a recent study of Greenland ice, lead concentration had decreased by a factor of 7.5.

19

GREENHOUSE EFFECT: During the summer drought of 1988, alarmed scientists sounded a dire warning: The world is growing dangerously warmer, due to the greenhouse effect—



the process by which carbon dioxide and other gases from power plants and automobiles absorb the sun's infrared rays, much like the walls of a greenhouse. The experts cautioned that rising temperatures from the buildup of fossil-fuel gases would in time flood coastal areas and turn cropland to wasteland. A worldwide debate, however, is also warming up. Other scientists have characterized the temperature increase as a typical climate shift.

20

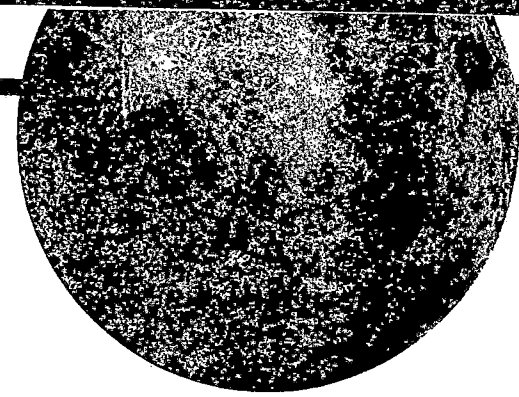
POPULATION EXPLOSION: The world presently supports more than 5 billion people. Because population growth is exponential, a staggering 10 billion people will share the planet's diminishing resources by the year 2025. Scientists are worried that food production or the earth's capacity to absorb waste may not keep up with demand. Moreover, with widespread deforestation, the need for firewood, the Third World's principal fuel, will increasingly exceed sustainable yields. Other forces may serve to curb the population crisis: Science may develop ways to accelerate food production, and disease, already wreaking havoc in the Third World, is sure to devastate pockets of the earth's people.

21

OZONE MADNESS: Stratospheric ozone levels over Antarctica have reached the lowest levels ever recorded, according to recent satellite reports. In other words, that ozone hole is now immense. Watch out for an increase in skin cancer worldwide.

22

GAIA HYPOTHESIS: In 1972, British scientist James Lovelock had a vision: The earth was a giant living organism whose bodily functions were the atmosphere, the seas, life itself. Calling his theory Gaia ('guy-ah') for the mother Earth goddess, Lovelock proposed that environment and life are two parts of a single system which interact in a self-regulating and self-correcting way. Critics say Gaia can't be proven and therefore is more akin to philosophy or religion, not science.



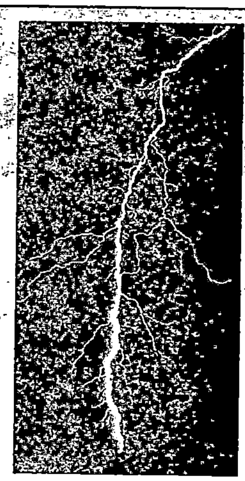
QUESTIONS KIDS ASK

23

MOON IN MOTION: The moon has earthquakes—or, more accurately, *moonquakes*. Most of these very weak quakes are caused by tidal forces resulting from increases in the Earth's gravity as the moon moves closer to the Earth during part of its orbit. Others most likely occur when molten or partly molten rock below the moon's surface shifts. Moonquakes last longer than earthquakes—the landing of the Apollo 12 lunar module set the moon vibrating for more than two hours.

24

THUNDER: is caused by lightning; the two are inseparable. A lightning bolt heats the air around it to 50,000°F, and this hot air does what every hot thing does—it expands. This incredibly fast expansion produces a sound akin to a sonic boom.



25

SKELETON BEACH: That soft, white sand you curl your toes in when you go to the beach is not miniscule shavings of rock, as you might think. Instead, it's the skeletons of ancient plants and animals. Some of those organisms used calcium, either as part of their own skeletons or as a shelter. Others were literally made of glass and absorbed silica, the main ingredient in glass, from sea water and ocean-floor clay. Over the years, water and other organisms ground these plants and animals down into the granules of sand that form our beaches. By the way, the grayish sand usually found elsewhere, like in your backyard, did indeed come from the erosion of rocks.

26

DON'T SUCK: Doctors now know that the time-honored advice for treating a snake bite—making an incision at the bite and sucking out the venom—doesn't really work and may do more harm than good. The incision is prone to infection, and the suction method has been found to remove at best just 18 percent of the venom. Also, doctors recommend trying to *slow* the circulation of blood with something like an Ace bandage rather than trying to *stop* it with ice or a tourniquet; the bitten area badly needs blood to reduce potential tissue damage. And if the snake attacked in self-defense, the bite victim is better off than if it was looking for food; it injects more venom into its prey to paralyze or kill it quickly.

27

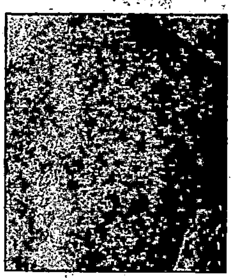
ICE is denser than room-temperature water, and heat rises. Sunlight should heat the surface of water faster than water at the bottom. So why doesn't ice form on the bottom, instead of the top of bodies of water? It turns out that water reaches its greatest density *before* it freezes—at 39.2° F heit. It then expands as it freezes, so the water between 39.2° and 32° (the freezing point) is less dense and thus rises to the surface. As water at the freezing point turns into ice, the various crystals bond together and expand, remaining on the surface because of their lower density.

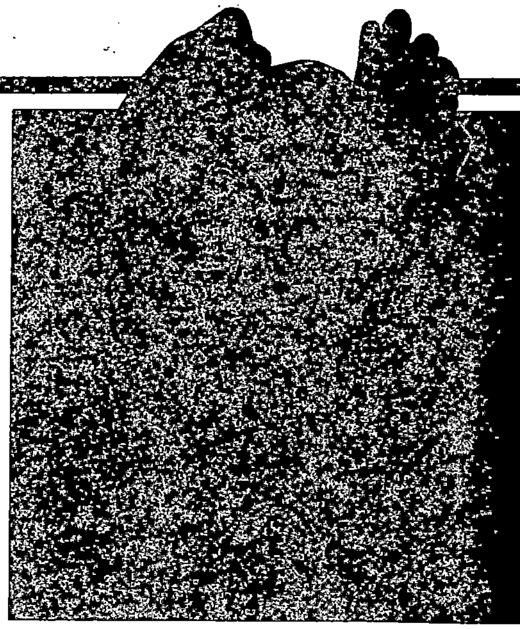
Hail to Thee, O Isaac Asimov!

How to pick the best out of Asimov's science books? Not easy. But those of us who have read and loved Isaac's work have learned from him that the easy way is rarely the right or the best way.

Here's my pick of the 10 best of Isaac Asimov's science books.—Keith Ferrell.

Asimov's New Guide To Science—Every home needs one. *Asimov's Biographical Encyclopedia Of Science & Technology*—The women and men behind the history. *Asimov's Chronology Of Science & Discovery*—Who did what, and when. *The Human Body*—How we work. *The Human Brain*—How we think. *Understanding Physics*—Hard science made simple. *Realm Of Numbers*—Trouble with arithmetic? Read this. *Essays*—*Any* of Isaac's collections of succint articles and essays. *Our Angry Planet*—Written with Frederik Pohl, this is an eloquent examination of the damage we're doing to our world. *Atom*—A new book and a masterpiece.





28

SALT in the oceans comes from several sources: minerals from eroded rocks that are carried into the ocean by rivers, volcanic rock, and basalt that erupts up from below the ocean floor. The concentration of salt has remained stable at about 3.5 percent for about 1.5 billion years.

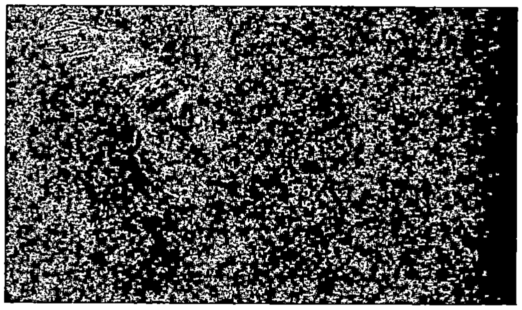
29

LIGHT WEIGHT: A square mile of sunlight weighs about three pounds. Sunlight has weight because it exerts pressure on anything it encounters. If all the sunlight reaching Earth could be weighed, it would tip the scales at more than 87,000 tons.

30

GALAXY IN MOTION: Like the planets, our galaxy, the Milky Way, revolves. The galaxy takes its time to revolve: 230 million years, known as one galactic year. The Milky Way has only been around for about 52 galactic years, or 12 billion years. Our sun, the earth, and the other planets trek over a million trillion miles each galactic year.

GRAY MATTERS



31

CONNECTED: There are 200 billion neurons in the brain; 10 to 50 times that many glial, nutritional, and "support" cells; millions of trillions of connections between these cells.

32

ON THE SURFACE: The surface area of the human cerebral cortex is 10 times as great as a monkey's; 1000 times as great as a rat's.

33

ACME CELLS: One typical neuron, a pyramidal cell, has up to 100,000 specific connections to other cells. "The pyramidal cell is the acme of biochemical evolution."—Dominick Purpura, Dean, Albert Einstein College of Medicine, New York.

34

MORE THAN SEE: There are 125 million rods and cones in the retina whose impulses follow the pathway to the primary visual cortex, the size of a postage stamp. In monkeys, the primary visual cortex is 15 percent of the whole surface of the cortex; in humans, 3 percent, meaning humans have five times as much higher processing of initial visual images.

35

BRAIN GENES: Only 1 million genes are necessary to encode for the growth, development, and function of the brain throughout life.

CONTINUED ON PAGE 104

36

HEADY WEIGHT: The average brain weighs about three pounds. Lord Byron had one of the heaviest—5 pounds, 2.25 ounces.

37

DISPROPORTION: The brain makes up 2 to 3 percent of body weight but uses 20 percent of all oxygen.

38

PARTS: The limbic system, evolutionarily older than the cerebral cortex, is essential for behavioral and emotional expression. The hippocampus, an area of the limbic system, is essential for learning and memory processing.

39

HEARTS AND BRAINS: The brain uses 15 percent of all cardiac output, three-quarters of a quart to 1 quart of blood a minute.

40

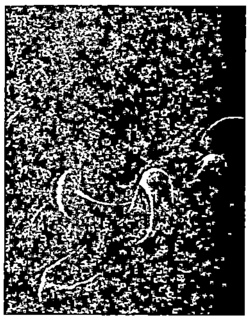
AT THE TOP: The brain is the enlarged end of the spine.

41

TWO DEFINITIONS AND A REVISION: *Brain death*: when *no* part of the brain functions. *Persistent vegetative state*: Part of the brain is destroyed. The brain stem, the most *primitive* region, usually remains mostly intact. A person in a persistent vegetative state has reflex functions but is incapable of any thought, intellect, memory, speech, or awareness of self or environment. *Cognitive death*: Some bioethicists, philosophers, and physicians think the definition of death should be expanded to include persistent vegetative state.

42

END: Disruption of blood flow to the brain for eight to ten seconds leads to dysfunction; three to five minutes leads to permanent brain damage; after five minutes, death.

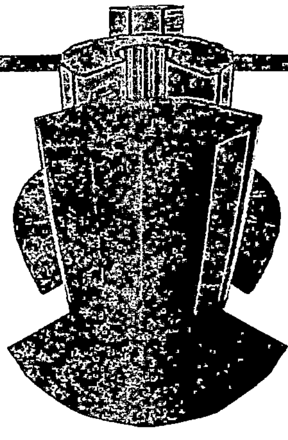


43

DEPRESSING FIGURES: At any time in the U.S., 12.6 percent of the population suffer from a mental disorder. Over 25 percent of the population suffer a mental disorder in their lifetime.

INFORMATION INFORMATION

44



HOW SUPER?: Even computer experts have a tough time defining a supercomputer. The general consensus is that it is the fastest computer in the world. The fastest computer 20 years ago was much, much slower than the fastest computer today, but both were supercomputers. Today, a supercomputer performs around 100 million floating-point operations per second.

45

ARTIFICIAL LIFE consists of manmade pieces of computer code that behave much like living things: They reproduce, often producing varied offspring; they contract debilitating illnesses; they die.

46

VIRTUAL REALITY: A computer hardware/software technology that persuades users of the "reality" of artificial environments. Using optical devices, very fast processors, and sensors and — feedback devices attached to human users, virtual reality allows practitioners to move through simulations of real environments such as rooms and houses, to achieve the illusion of flight, to visit historical antiquities or distant worlds—all artificially created by computer. Still in its infancy, VR promises to alter, perhaps forever, the worlds of entertainment, education, science, and industry.

47

COMPUTER VIRUS is a piece of computer code that contains instructions to do at least two things: Place a copy of itself in any other computer system it contacts (for example, over a computer network) and perform some task, such as placing a particular message on the screen. Specially designed programs, often called vaccines, can find and neutralize viruses.

OUR BODIES, OUR CELLS

48

LEUKEMIA AND THE RICH: A recent study from the British Office of Population Censuses and Surveys shows that children from wealthier families are more likely to develop leukemia. The reason, researchers speculate, is that children in richer families may be exposed to an offending virus later than those in poorer families. That delayed exposure may trigger abnormal cell proliferation.

50

MOZART'S SKULL: It's long been thought that the body of the great composer Wolfgang Amadeus Mozart was lost in a large communal grave. His skull, however, was said to reside in Salzberg's Mozarteum. Is it true? Apparently yes, according to a group of French researchers who say they have positively identified the skull. The anthroplogists, from the University of Provence, reconstructed the head in clay and found it matched historical as well as contemporary portraits of the composer.

AND FINALLY . . .

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THE FUTURE IS: a)beyond our control *(NOT!)*, b) where we'll spend the rest of our lives, c) what we make of it.

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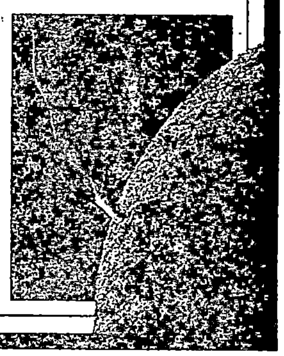
HITCHING A RIDE ON SPERM: It's known that drugs taken by pregnant women can damage the fetus. Recent research from the Temple University School of Medicine suggests that cocaine can hitch a ride on sperm, enter the egg, and damage the developing embryo. A. Yazigi, head of the research, suspects that paternal cocaine abuse causes defects such as learning disabilities and memory problems.



SCIENCE

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NUMBER 5039

Molecule of the Year

When the robots of nanotechnology start playing soccer-football, they will have the perfect molecule to kick around, a buckyball, and they will have no more fun than today's buckyball scientists.

The Molecule of the Year Award was initiated to highlight contributions in science to an improved quality of life and to emphasize that most scientific discoveries are the product of many dedicated workers who lay the groundwork, design the experiments, recognize the importance of the unexpected, and exploit breakthroughs. Sometimes these discoveries are immediately applicable to practical products. In other cases they are recognized as major turning points following on a historical tradition that a basic new understanding of nature inevitably leads to practical applications. Such is the case in this year's selection of the Molecule of the Year: the C_{60} molecule, referred to as buckminsterfullerene, buckyballs, or C_{60}. This molecule, and the family of fullerenes derived from it, were named after the architect whose geodesic dome provided a prophetic vision of its atomic counterpart and who was a powerful evangelist for the relation of structure to function. C_{60} burst into physics and chemistry only a few years ago and has captured the enthusiasm of experimentalists and theoreticians. It has incredible symmetry for such a large molecule, in which 60 carbon atoms are joined with a mixture of single and double bonds arranged in 20 hexagons and 12 pentagons. Its chemical versatility is astonishing, reacting with alkali metals such as potassium and rubidium, halogens such as fluorine, free radicals, and Grignard reagents. The molecule itself and many of its derivatives are readily soluble in organic solvents, but recently amino adducts have been added which make it soluble in water.

In addition to opening up new fields of chemistry, C_{60} also is showing interesting physical properties. It is so resistant to shock that it has been suggested as a lubricant, there is evidence of superconductivity, and it may provide the added ingredient that makes diamond films more practical. There is no short step to a practical application of its superconducting properties, but the surprising finding that C_{60} does exhibit superconductivity opens up new theoretical avenues which may ultimately lead to a more profound understanding of superconductivity in general.

Science has always believed that structure throws light on function and vice versa, and therefore the appearance of a new structure presages new ideas. As it is, in the short time since the discovery of C_{60}, the chemical and physical literature has been filled with novel reactions and properties, and there is added excitement from the expectation that this is only the beginning. In a recent issue of *Science* highlighting new approaches to curing and preventing cancer, it was impressive that so many contributions came from developing a general knowledge of biology, medicine, and chemistry. Understanding of growth factors, of viruses, of mutations of DNA, of membrane receptors, and of metabolism was the forerunner of therapy and prevention of cancer. The findings in this example support the belief of scientists that basic research is almost invariably correlated with practical applications. That correlation, which could be repeated in many other fields, is a particularly important feature of the fullerene many-ring circus. The versatility of this molecule means not only that it is important in itself, but that the challenge to explain its unusual structure and properties will clarify understanding of molecules that do not look at all like a geodesic dome.

In the accompanying Molecule of the Year story, the properties of C_{60} and the nine runners-up for Molecule of the Year are discussed, but at this moment, there seems little doubt that the new horizons opened by the fullerenes make them the best choice.

Part of the exhilaration of the fullerenes is the shock that an old reliable friend, the carbon atom, has for all these years been hiding a secret life-style. We were all familiar with the charming versatility of carbon, the backbone of organic chemistry, and its infinite variation in aromatic and aliphatic chemistry, but when you got it naked, we believed it existed in two well-known forms, diamond and graphite. The finding that it could exist in a shockingly new structure unleashes tantalizing new experimental and theoretical ideas. Perhaps the least surprising might be that improving life through science is a path that would see all the citizens of the world holding hands like carbon atoms in C_{60} and like them, welcoming any newcomer, no matter how different his or her skills or challenges.

—DANIEL E. KOSHLAND, JR.

Buckyballs: Wide Open Playing Field for Chemists

The roundest, most symmetrical large molecule found so far, buckminsterfullerene, continues to astonish with one amazing property after another. Named for American architect R. Buckminster Fuller, who designed a geodesic dome with the same fundamental symmetry, C_{60} is the third major form of pure carbon; graphite and diamond are the other two.

Buckyballs were discovered in 1985—the by-product of an experiment on carbon molecules in space—but it was in 1991 that buckyball science came into its own. This year scientists flocked to the buckyball court, entranced by the molecule's unusual bonding behavior, its hollow symmetry, and its amazing electronic properties. Rarely has one molecule so swiftly opened the door to a new field of science.

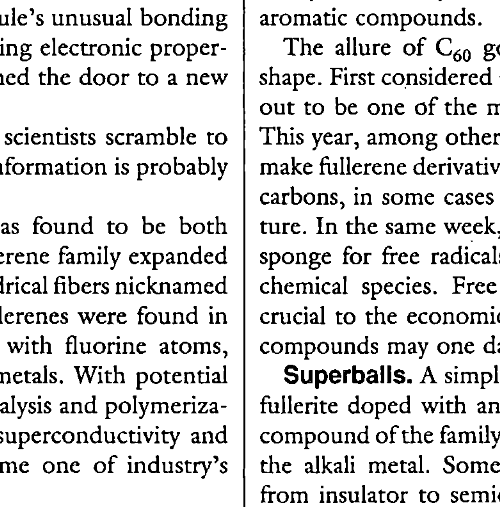
Papers hit top journals every week or so; scientists scramble to keep up by fax and E-mail, and month-old information is probably out of date.

In the past year, properly doped C_{60} was found to be both superconducting and magnetic, and the fullerene family expanded to include asymmetrical forms as well as cylindrical fibers nicknamed buckytubes. In a steady stream of firsts, fullerenes were found in flames, decorated with free radicals, hung with fluorine atoms, inflated by carbon rings, and stuffed with metals. With potential applications in such commercial basics as catalysis and polymerization as well as the more distant realms of superconductivity and ferromagnetism, buckyball may soon become one of industry's favorite sports.

All-star teams. From the beginning, buckyballs have been the sport of physicists, materials scientists, and inorganic as well as organic chemists. At first physicists led the way, pointing out the exceptional electronic properties of the fullerenes, but this year, with grams of C_{60} available, chemists also have taken to the field in full force, and interdisciplinary teams of scientists are together exploring the round world of buckyballs.

In the fall of 1990, scientists found that heating a rod of graphite in a helium atmosphere produced C_{60}. Labs around the country began cooking up bins of buckyballs, sparking an explosion of research. And in July, buckyball genesis was made potentially even easier by the discovery that they are found in the sooting flames of burning benzene. Although C_{60} is still relatively expensive—at least $2,000 per gram in purified form—many predict that fullerite (the pure, solid form of C_{60}) ultimately will be a bulk commodity, sold in local chemistry supply stores for dollars per pound.

Marriage of the molecules. Last year, the brilliance of synthetic diamonds as superhard materials beat out buckyballs for Molecule of the Year. But one shadow dimmed diamond's luster: A polish of diamond itself was often required to grow synthetic diamond film—an expensive and often impractical beginning. This year, buckyballs came to the rescue. Researchers coated silicon with C_{70}, then grew diamond on top. Voilà! The rugby ball-shaped fullerenes increased diamond formation by 10 orders of magnitude over the untreated silicon.



J. BERNHOLC ET AL., NCSU/T. PALMER NC SUPERCOMPUTING CENTER

Playing ball in three dimensions. Just how do buckyballs manage their chemical and physical feats? In C_{60}, hexagons and pentagons of carbon link together in a coordinated fashion to form a hollow, geodesic dome with bonding strains equally distributed among 60 carbon atoms. Some of the electrons are delocalized over the entire molecule, a feature even more pronounced in that workhorse of organic chemistry, benzene. But benzene is flat, and many of its derivatives also tend to stack in flat sheets. Spherical buckyballs literally add a new dimension to the chemistry of such aromatic compounds.

The allure of C_{60} goes beyond the beauty of its symmetrical shape. First considered a paragon of physical stability, it has turned out to be one of the most chemically versatile molecules known. This year, among other pioneering steps, chemists learned how to make fullerene derivatives, inflating the C_{60} balloon by one or more carbons, in some cases still preserving its aromatic electron structure. In the same week, it was reported that C_{60} acts as a veritable sponge for free radicals, able to absorb dozens of these reactive chemical species. Free radicals with one unpaired electron are crucial to the economical polymerization processes, and fullerene compounds may one day be useful in such industrial processes.

Superballs. A simple C_{60} cage easily accepts electrons, so solid fullerite doped with an alkali metal like potassium forms a stable compound of the family called fullerides with increasing amounts of the alkali metal. Some fullerides become chameleons, changing from insulator to semiconductor to superconductor and back to insulator again. Pure C_{60}, for example, is an insulator. K_3C_{60} is a superconductor; K_6C_{60} is an insulator. The superconductive properties have unfolded at astonishing speed. In April, the critical temperature was 18 K; by November, maybe 45 K, thanks to novel dopings of C_{60} and its rugby ball-shaped cousin, C_{70}, with metals and alloys of rubidium, cesium, and thallium.

The fullerides can't yet run in the same league as the traditionally hot candidates for high-temperature superconductivity, the metallic copper oxides, which have set the superconductive record at about 125 K. But because the fulleride materials are a much simpler system, they may offer a window into the still mysterious mechanisms of superconductivity.

Magnetic buckys. Ferromagnetism, like superconductivity, remains a mysterious electronic property of certain materials. This year, buckyballs proved that they can play magnetic games too. Add an organic reducing agent to fullerides and the totally unexpected result is a "soft" organic ferromagnet at temperatures up to 16 degrees K. The new material won't stay magnetic in the absence of an outside field, and so in itself may not have practical applications. But the ongoing quest for an organic ferromagnet, which would be prized for its light weight and ability to be polymerized, suddenly broadened its scope to include the fullerenes.

Cagey chemistry. For years chemists have been painstakingly building molecules with cavities, and fine-tuning the properties of those cavities in order to hold and transfer different atoms and ions. Now, with a naturally hollow molecule dropped into their laps, chemists are eagerly discovering the rules for how buckyballs can be filled. Eventually, by combining approaches, chemists may tailor-make stuffed buckyballs to serve as molecular containers, shields for radioactive compounds, or drug-delivery agents. This year, lanthanum atoms were stuffed inside buckyballs using the ship-in-a-bottle trick: form the cage around the stuffing. The next goal is to open a door into the fullerene cage, while still preserving that fragile electron structure, to allow direct movement of atoms or ions inside.

Twist and shout. Not all the fullerenes have the perfect symmetry of C_{60}—but even a lopsided structure can be promising. C_{76} and C_{84} have been found to have a helical form. C_{78} also has a chiral form, explored on page 1768 of this issue. Starting with planar graphite and ending with chiral carbon is surprising enough, but the asymmetrical forms may have fancy applications too, such as the creation of nonlinear optical materials. When exposed to light of one frequency, such a material would emit light of another, acting as an optical switch.

Buckytubes. One of the year's most exciting developments turned up in the dirt piles of old fullerenes. In the soot on a carbon electrode used to make fullerenes were found needles of carbon, composed of very thin nested tubes. Within each individual rolled-up sheet, the carbon molecules were apparently arranged in a helical structure. Fullerene tubes may possess an amazing mix of properties—including great strength, since fibers of conventional forms of carbon are already the strongest known. Evidence is mounting that the higher fullerenes—such giant molecules as C_{240}—may not be symmetrical like the prototypes, C_{60} and C_{70}. Rather, the larger molecules may be asymmetrical and incorporate buckytubes in their structures.

Starting reactions. Carbon cages are likely to make good catalysts, thanks to their bonding behavior and geometrical features, so industrial chemists are watching the buckyball play closely. This year, the outside of carbon cages was decorated with complexes of nickel, palladium, and platinum complexes, a feat that may eventually offer more than just a pretty molecule.

Injuries on the field? Many potentially useful organic compounds have a crippling fault: They tend to be intercalated into DNA and thus promote cancer. But buckyballs suffer no such flaw. They appear to be too big and round to be incorporated into DNA as are some of their planar cousins.

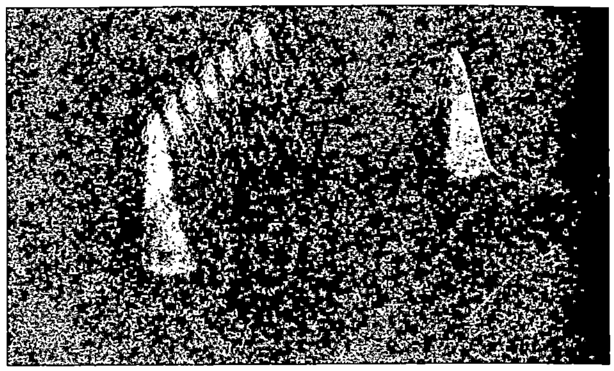
Buckyballs face a potential red flag of their own, however. In the presence of light and oxygen, the C_{60} molecule can pass its superfluous excitation energy onto nearby oxygen molecules, creating a long-lived but very reactive form of oxygen called singlet oxygen. Bucky boosters point out that even such a threat may hold promise. When not in an excited state, C_{60} quenches the reactivity of other singlet oxygen species. Unmodified fullerenes are insoluble in water, suggesting that they may react very little with biological tissue. Carcinogenicity tests are ongoing, but thus far buckyball looks like one of the safer games in town.

As fullerene science takes off in all directions, speculations as to its uses abound. Will it be superconductivity that makes fullerenes commercially important? Super-strong fibers? Catalysts? Too soon to say, but buckyball players aren't exactly worried about a lack of applications. At this point, the heady atmosphere of discovery is too strong. After all, so far fullerene science exhibits the classic profile of a major scientific breakthrough. Buckyballs were found by accident by researchers asking a completely different question. Then they were steadily explored—until they became widely available and the field exploded. Now, buckyball scientists are enjoying the exponential phase, in which almost everything is new and the unexpected is expected. Eventually, the action will focus on a few promising research veins, and then practical applications will bloom. For now, chemists, physicists, and materials scientists are simply having a ball.

And the Runners-Up Are...

Scientists hit homeruns in many fields this year, as they explored new territories ranging from planets to atoms. *Science*'s nine runners-up for Molecule of the Year—exciting discoveries need only be "honorary" molecules—are described below.

Microscopic manipulations. Extending human perceptions into the atomic realm has been a scientists' dream for decades, but in 1991, that dream became a useful part of reality, thanks to the scanning tunneling microscope (STM). An STM initially offered the perception aspects at the atomic level, but recently the microscope has been shown to be able to pick up atoms and move them about. The scope works by inducing a tunneling current of electrons between its tungsten tip and the sample. If the current is kept constant, the probe rises and falls, creating a map of the sample's topography. Sharply increasing the current allows the tip to pick up atoms delicately and transport them. As an imaging tool, the STM is available from about 20 commercial sources and is already a workhorse of materials science. As an atomic forceps, STM applications are just beginning. For their first attempts at moving atoms, scientists pulled stunts like writing "I love STM" in xenon atoms. But in the past year, they systematically explored the tricks of atomic manipulation. Atoms were dragged along a surface, picked up and set down somewhere else. A single atom can be induced to diffuse by applying a voltage between the surface and the STM tip. Practical applications are still years away, but the possibilities for atomic assembly are endless, including creating new molecules or building synthetic versions of precious natural ones. Atomic switches, which flip a current on and off by moving a single atom and which were demonstrated for the first time this year, could theoretically shrink computers by several orders of magnitude—and allow readers to store a year's worth of *Science* on a disc the size of a penny.

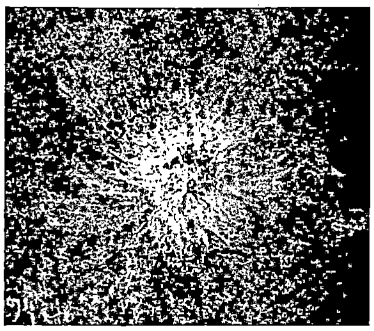


The first hand-built atomic structure. Seven Xe atoms banded together to form a linear chain on the Ni (110) surface. The image is 50Å x 50Å.

Venusian visions. Planetary scientists have always had a basic problem: Studies of active geologic and atmospheric processes on Earth-like planets were chiefly based on one planet—Earth. In 1991, detailed information was obtained for another planet, thanks to an interplanetary voyager called Magellan, which began to orbit Venus in August 1990. Despite some early problems, Magellan's big radar antennae sent back eerily beautiful radar photos of the surface of Venus. The new photos (which Magellan gathered by beaming microwaves to the surface through the clouds that shroud the planet, picking up the echoes and sending records back to Earth for processing) are a technological triumph, 10 times as sharp as any previous Venusian views. They show huge impact craters flooded with radar-dark material, giant volcanic calderas, dramatic mountain ranges, and evidence of Silica-rich volcanism, such as thick lava puddles 25 km in diameter. Already it's clear that Venus is no twin to Earth, bearing little evidence of Earth-like plate tectonics. One other 1991 Venusian news flash: more proof that the planet's heavy sulfuric clouds are sometimes pierced by lightning. The lightning's telltale radio signals were picked up by a plasma wave instrument aboard the Galileo spacecraft, which enjoyed a brief rendezvous with Venus in 1990. Meanwhile, Magellan's work was so successful that its mission has been extended; a third mapping rotation begins in January. For those who have seen Venus with new eyes, the twinkling star of evening and morning will never look quite the same.

That sinking feeling. Stratospheric ozone, or rather the lack of it, has been a scientific concern for several years, but in 1991 public awareness reached a new high, as the ozone hole over Antarctica expanded. This year, ozone losses hit home for denizens of the Northern Hemisphere too. The protective layer has thinned by about 3% over northern latitudes in the past decade. Even during northern summers—typically a seasonal high for ozone as well as prime time for sunbathing—ozone has declined. As a consequence, human exposure to ultraviolet light is expected to increase. If ozone drops by an average of 10%, the United Nations Environmental Program predicts that there will be 1.6 million new cataracts and 300,000 skin cancers worldwide annually. On the positive side, the Montreal Protocol, which calls for phase-out of ozone-eating halons and chlorofluorocarbons by 2000, was implemented this year. Environmentalists say faster phase-out is needed, but even critics agree the protocol deserves respect as the first international treaty to tackle a global environmental problem. Meanwhile, using satellites and aircraft, scientists continue to explore the dynamics of ozone destruction. But even if ozone loss can be slowed, how can the existing hole be filled? Some atmospheric scientists suggested one possibility this year: break the ozone-destroying chain reaction by dumping 50,000 tons of ethane or propane into the Antarctic stratosphere to scavenge reactive chlorine free radicals.

JPL/NASA



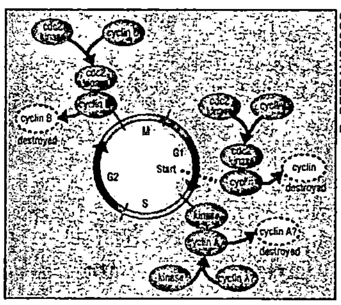
The volcano Sapas Mores on Venus erupts with molten lava 250 miles across with some similarity to eruptions in Hawaii.

Growth factor. True to their name, colony stimulating factors (CSFs) spur colonies of immune cells to grow in Petri dishes. But in 1991, CSFs swept into clinical medicine, with two factors approved by the Food and Drug Administration. Naturally produced in the human body, recombinant CSFs can be used to stimulate production of key white blood cells, which destroy bacteria and viruses. Chemotherapy kills such cells, leaving patients vulnerable to infection and dependent upon antibiotics. To regain their health, tens of thousands of patients getting chemotherapy also receive granulocyte colony stimulating factor, (GCSF), which allows more intense and frequent doses of chemotherapy. Patients who receive GCSF need fewer antibiotics, recover earlier, and go home sooner, making the medicine a cost-effective strategy. It's not only cancer patients who benefit. GMCSF (for granulocyte-macrophage colony stimulating factor) was approved for bone marrow transplantation this year. Meanwhile, basic research on the factors continues; the molecular structure of GMCSF is presented by Diederichs *et al.* on page 1779 of this issue. Theoretically, anyone who suffers from impaired immunity may profit from CSFs; trials with AIDS patients are under way. Trials are also under way on people who have normal immune cell counts but are fighting serious infections, like pneumonia, and could use an immune cell boost. The CSFs are also pretty good at stimulating stock portfolios. Amgen stock rose by 180% this year. The two approved CSFs are expected to garner $450 million in sales in 1992, and that's only the tip of the iceberg, with more than a dozen CSFs and their cousins, the interleukins, waiting in the wings.

SIMON FRASER/PHOTO RESEARCHERS, INC.

Pediatric nurse adjusting an intravenous line being used to deliver chemotherapy drugs to a young boy with leukemia.

Cycling into cancer research. Like miners following their separate veins of gold, basic scientists for years have explored the subtleties of the cell cycle while cancer researchers explored the genetics and pathology of the disease. This year, both groups have found themselves digging away at one promising vein, which could lead to the motherlode: proteins called cyclins and their working partners, the cdc kinases. Originally, researchers thought that one or two cyclins paired up with a kinase (enzymes that modify proteins by phosphorylation) to trigger cell division. This year the cyclins and kinases have multiplied into a complex cast of characters, including five distinct families of cyclins and perhaps 10 cdc kinases. Together, these proteins may regulate the cell cycle at a series of key points. For example, this year researchers looking for a gene involved in a benign parathyroid tumor stumbled into cyclin research, finding that the protein encoded by their tumor gene is a cyclin. Other groups (who were actually looking for cyclins) found the same cyclin, now called cyclin D. Meanwhile, cyclins are suspected of binding with the protein encoded by a well-known tumor suppressor gene, the retinoblastoma gene. There are even tantalizing hints that cyclins are involved with the protein product of the *p53* gene, a tumor suppressor that is the most frequently mutated gene in some human cancers. This year, the cell cycle picture became much more complex and a little less mysterious. Eventually, resetting the cellular clock could stop the wild reproduction of cancer cells or nurture the regrowth of cells in damaged organs.

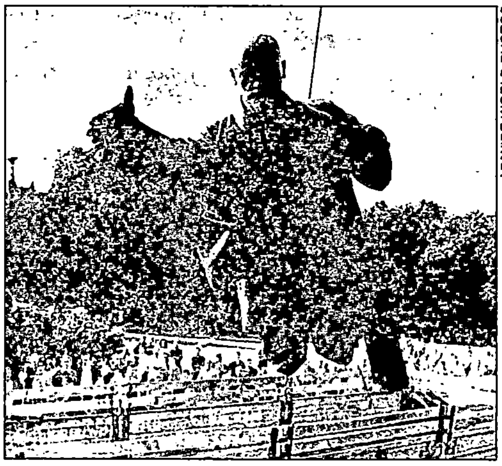


D. DEFRANCESCO

Cyclins and the kinases related to them have key roles in controlling the cell cycle.

Immunologists look inward. In the past few months, a series of fast-paced developments in immunology has begun to unravel the story of the way antigens are processed into strips of peptide and displayed for recognition by lymphocytes. For this internal processing duty, the immune system has coopted existing cellular machinery. In one antigen-processing pathway (class I) there are two steps—first, digesting the proteins and second, transporting the peptides to the binding site. The new genes were found in a small area of the genome that contains other genes of the major histocompatibility complex (MHC). Also in late 1990 and in 1991, several of the peptides bound to the MHC molecules (both class I and class II) were sequenced for the first time. Since vaccines mimic these peptides in order to arouse an immune response, knowing the detailed sequence is likely to lead to more potent vaccines. For example, MHC class I molecules incorporate surprisingly short peptides, typically only nine amino acids long. Most current vaccines are generated by a much longer and therefore less effective chain. Since the immune system sometimes attacks its own proteins (the autoimmune diseases), knowledge of these peptides may also be the first step to creating drugs to block the unwanted response.

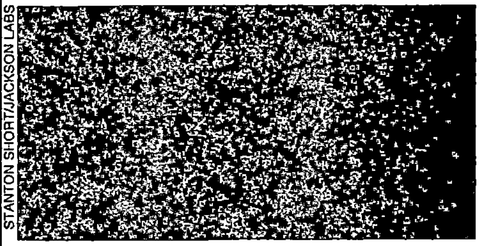
Market rules. For more than 70 years, the Soviet Union ran a sweeping economic experiment on a scale so grand no social scientist would ever dare propose it. Spurning free markets, the Soviets did their best to craft a planned economy, setting prices and directing factory output for the entire nation. Meanwhile, from the 1930s to the '50s, Western economic journals hosted a fierce debate. Could a centrally controlled economy run smoothly by mimicking a free market? Socialists argued that inventories could signal supply and demand just as well or better than prices. But other economists insisted that nothing could match the wealth of information about tastes and technologies that is contained in a free market price. Those theoretical debates ended inconclusively, and the journals turned to other issues. But in 1991 the Soviet Union crumbled from within, offering strong support for the market economists. Economists around the world are now concluding that central planning does not motivate citizens and cannot transmit information as efficiently as a free market. The demise of the USSR does not prove, of course, that every aspect of an economy should be left to Adam Smith's famed invisible hand. But in the wake of the Soviet experience, the question is no longer market economy vs. central planning. Rather, it is how best to create a market economy while minimizing hardships.



AP/WIDE WORLD PHOTOS

Lenin's statue comes falling down. A rope removes Lenin from a pedestal in Lithuania as symbol of the collapse of his economic system.

Genes on target. Homologous recombination, the act of slipping a mutated gene into the correct place on a chromosome, was first accomplished about 4 years ago. But in 1991 the technique's chimeric offspring began to appear in large numbers. A zooful of altered mouse lines has now emerged, setting the stage for a new set of powerful mammalian model systems for human diseases. Biologists are working on creating mice to provide models for common human diseases, such as cystic fibrosis and many types of cancer. Before homologous recombination, geneticists working with transgenic mammals could introduce a mutated gene into cells but could not control where the gene went on a chromosome or how many copies were inserted. Only in yeast could altered genes be inserted on target. But now mammalian geneticists can study living mice with carefully targeted mutations, thanks to homologous recombination and another relatively new technique, that of culturing embryonic stem cells and reinserting them into the developing mouse. The scientific rewards are rolling in. For example, in 1991 several of the homeobox genes—key genes that regulate development and have been conserved throughout evolution—were disrupted by targeted mutagenesis and put back into mice. Most times homologous genes have homologous effects in different species but sometimes the results are surprising. For example, mutated *Drosophila* show drastic effects if missing a homeobox gene called *engrailed*, but knocking out the homologous gene in mice produced normal mice with only slight changes in brain tissue, suggesting that there is more redundancy than expected in the mammalian genetic plan. Meanwhile, the homologous recombination technique continues to be refined, so that as of this year, the technique can be used extensively.



STANTON SHORT/JACKSON LABS

Yellow obese mouse. The mouse is heterozygous for a gene that alters coat color and tumor susceptibility.

Rousing receptors. As the most widespread neurotransmitter in the brain, the simple amino acid L-glutamate has powerful and diverse effects, with roles in development, learning and memory, and neurological diseases and stroke. This single molecule triggers a variety of events because different receptors respond to glutamate in very different ways. This year, the genes that code for several receptor types were found, which marks a giant step toward understanding their detailed functions and providing therapy for malfunctioning cells without interfering with normal brain processes. The elusive metabotropic receptor was cloned this year, as was the long-sought NMDA receptor (for N-methyl-D-aspartate, a synthetic compound that activates this receptor). Finding the NMDA receptor was a prize discovery, in part because this receptor, which allows calcium ions into the cell, is involved in the brain damage left by a stroke. The damage is done when cells become overstimulated and calcium floods the cell, in a process called excitotoxicity. Conventional wisdom held that only NMDA receptors were permeable to calcium, but this year scientists revised their views: certain subunits of another class of receptor, the non-NMDA Slutamate receptors called kainate-AMPA receptors, also can trigger the flow of calcium. And this summer two groups independently found that the genes that code for these receptor subunits differ by only one amino acid, which means calcium permeability is genetically controlled by one amino acid in these receptors. These developments suggest that the non-NMDA receptors also may have a role in calcium-dependent processes, which are believed to include learning and memory. And they raise the possibility that some day very specific drugs could turn off calcium permeability in a small subset of brain cells—without turning off the rest of the brain in the process.

—ELIZABETH CULOTTA AND DANIEL E. KOSHLAND, JR.

SCIENCE

21 DECEMBER 1990
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The Molecule of the Year

Diamonds may soon be everyone's best friend. According to enthusiasts, synthetic diamonds have already or will soon appear on watch crystals, eyeglasses, optical instruments, audio speakers, fuel injection nozzles, turbine blades, scalpels, and semiconductor wafers, to name only a few applications.

The remarkable properties of diamond were recognized long ago. The name originates from the Greek *adamas*, which means invincible. Diamonds, particularly large ones, are among the most desirable gemstones, but the scientific and industrial value of diamond films and small diamonds is perhaps even more striking. For hardness, for electrical resistance, for corrosion resistance, and for thermal conductivity, diamonds are at the extreme. Diamond also absorbs less light at most wavelengths, and also exhibits ten times greater thresholds to laser damage. Its thermal properties can be improved even further by making pure carbon-12 isotopic diamonds. Diamond circuits could be more stable and would remove accumulated heat more rapidly than the silicon wafers that are the current core of the semiconductor industry.

Last year a new feature, the Molecule of the Year, was initiated by *Science* with the idea of honoring the scientific development of the year most likely to have a major impact on scientific advances and societal benefits [*Science* **246**, 1541 (1989)]. The condition for selection was not that the development had to be discovered in the year of the choice, but rather that in that year the accumulation of experience and expertise indicated that the discovery was on a pathway of major importance. The polymerase chain reaction was picked as the Molecule of the Year for 1989, and the exponential increase in 1990 in its use in the laboratory, in industry, and in the courtroom supports that selection. Diamonds in 1990 seem to be at the equivalent stage. There are cost factors and theoretical problems to overcome, but the mounting excitement in conferences, journals, and industrial laboratories indicates that the threshold in the development of a new technology has been passed. A more detailed account of the diamond development, and of the runner-up candidates for Molecule of the Year, is given on page 1640 of this issue.

One of the intriguing aspects of the synthetic diamond technology is its relation to the discipline of materials science. That area of modern science, a child of physics, engineering, and chemistry, has flourished enormously in recent years, producing such practical applications as transistors, superconductors, and designer catalysts. Materials science has a history of symbiosis between academe and industry and is driven by the interplay between fundamental research and practical applications. Materials scientists constantly search for new phenomena and new combinations of existing properties. These discoveries can lead to previously unimaginable technologies or can decrease the cost of existing applications so that they become accessible to a wider range of problems. This is one of the reasons materials scientists are so excited about thin diamond films. They will now be able to exploit the incredible properties of diamond in situations that were discarded as impractical in the past. For example, electronic devices in which diamond forms the substrate, or backbone, for the device would be inconceivable without the ability to grow diamond as a film. Moreover, materials scientists are aware that knowledge diffuses like ions hopping in a lattice, so that other promising materials, such as boron nitrides, will benefit from the new science revealed by diamond studies.

As we watch the sudden rise in expectations and knowledge of diamonds, do we need to fear side effects of unknown consequence? No obvious difficulties are apparent, other than the economic readjustments usually accompanying any new technology. Electromagnetic radiation, antibiotics, and transistors are only a few of the scientific discoveries that have spawned new industries and enriched all our lives. That they have in turn created new societal problems should lead neither to cries of dismay nor shouts of alarm. Who really wants to get rid of television sets, life-saving drugs, or computers? Synthetic diamonds may well create new problems requiring new science and new ingenuity, but the potentialities for new frontiers more than outweigh the possible adversities.

Scientists who say, "The solution to problems created by science is more science," must expect to be viewed with a certain amount of skepticism by the general public. Scientists must therefore do their best to predict in advance that the mainline benefits are likely to outweigh the sideline problems, in which case the public will find that science, like diamonds, can be everybody's best friend.—DANIEL E. KOSHLAND, JR.


Bell Laboratories

Molecule of the Year

Diamond: Glittering Prize for Materials Science

Its combination of properties, like its appearance, is absolutely dazzling. Diamond is the hardest substance known. It is inert to chemical corrosion and can withstand compressive forces and radiation. It conducts heat better than any other material, has extremely high electrical resistance, and is transparent to visible light, x-rays, ultraviolet radiation, and much of the infrared spectrum. And, with respect to most of these features, diamond is superior to all other known materials.

Because of these outstanding properties, synthetic diamond materials—both crystals and thin films—that could be made cheaply would have great potential in research and commercial applications. Can they be produced? 1990 saw the start of the era in which this possibility could become a reality.

Diamonds in the rough. Before it was feasible to make synthetic diamonds, diamonds could only be obtained through mining, and never has there been what could be called a ready supply. Today, less than 20 tons of natural diamonds are mined each year throughout the world. Brazil, India, and South Africa have been, at different times, the world's major diamond-mining nations, though diamonds are also found in many other countries; today the Kaapvaal craton of southern Africa is one of the world's most productive diamond-mining centers.

Natural diamonds form in the earth's mantle in regions of high temperature and high pressure. Volcanic eruptions that originate from such regions bring diamonds to upper portions of the earth's crust in rocks known as kimberlites. Diamonds are mined from the conduits of the volcanos and from nearby placer deposits in stream beds and beaches.

The switch to synthetic. As new technologies have been developed for the production of artificial diamonds, the quest for diamonds has shifted more and more from the mine to the laboratory. The number of potential uses for diamond-based materials and the enormous profits anticipated have engendered an international race for high-quality artificial diamond production. Technologic breakthroughs for growing diamond materials and diamond films have come fast and furious in 1990. In addition, use of purer starting materials made possible the production of isotopically pure diamond films that have properties superior even to those of natural diamonds: the most exceptional of these is the extraordinary ability of the pure films to conduct heat. Although the cost of making synthetic diamond films with state-of-the-art chemical vapor deposition (CVD) methods is still high—estimated at around $100 per carat—the price could drop significantly with the optimization of CVD technology.

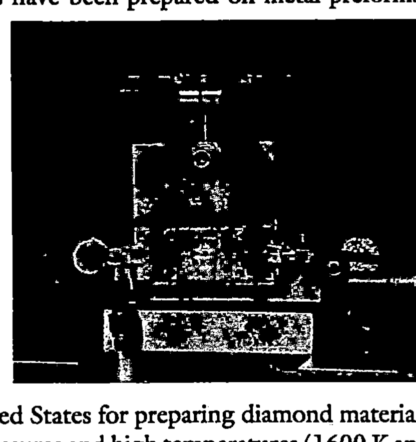
Applications. A few diamond-based and diamond-coated products are already in use commercially—x-ray windows in electron microscopes, strong abrasion-resistant industrial tools, and diaphragms for tweeters in stereo speakers—but these represent only a tiny fraction of the anticipated applications. For hard-to-service, hard-to-reach environments where high pressures and temperatures, intense radiation, high salt content, and other adverse conditions can destroy materials (places like the ocean, space, engines, and nuclear reactors), fabrication of diamond materials and devices may be justified already, even at the currently high costs of production.

In both adverse and more standard settings, diamond substrates for semiconductors will be able to efficiently transport heat from electronic circuitry, obviating the need for cumbersome cooling systems. Because CVD diamond films have both high thermal conductivity and high electrical resistivity, the jewel in the crown of diamond film technology may well be superfast integrated diamond circuits. Diamond diodes (the building blocks of transistors, which, in turn, are the building blocks of integrated circuits) have recently been made. If successful doping of diamond can be accomplished routinely, diamond devices could someday replace silicon semiconductors. Whereas silicon chips can withstand temperatures up to 300°C, one estimate is that diamond chips might be able to withstand temperatures as high as 5000°C.

Doped single-crystal diamond films are needed for diamond semiconductors; for other applications polycrystalline diamond films are adequate. For example, abrasion-resistant tools are coated with this type of film. Industry faces a different sort of challenge with regard to these tools, namely determining what would be an equitable price to charge for saws and knives that never need sharpening or replacement.

Diamond thin films can be put on windows and lenses to make them scratch-proof, nonreflecting, and permeable to light. Because diamond films are wear-resistant, they might be fashioned into efficient, low-friction, unlubricated bearings for machinery and prosthetic devices. A megaproject that may be in the offing is the production of diamond films for use as high-speed detectors for the superconducting supercollider; it is predicted to involve more than a million carats of diamond film.

In addition to the production of diamond films and coatings, free-standing diamond materials are being fabricated. Diamond nozzles have been cast for use in diesel engines, and diamond sheets, domes, and tubes have been prepared on metal preforms. Because the template is etched away, full advantage can be taken of diamond's extreme properties in the free-standing constructs.


Supplied by Don Kania, Lawrence Livermore Labs

The technological spadework. Interest in the production of artificial diamonds was expressed at the turn of the century, but it was not until 1958 that a method was patented in the United States for preparing diamond materials from methane at high pressures and high temperatures (1600 K and about 55 kilobars). However, as the methane burned, graphite was also deposited, severely limiting the speed of diamond deposition and therefore the success of the process. (Both diamond and graphite are pure carbon materials, but the way that carbon atoms are organized in them differs: diamond is a rigid, dense, and essentially incompressible crystal in which tetrahedrally coordinated carbon atoms are linked in a cubic crystal lattice by covalent bonds; graphite is a soft material in which two types of bonds form to create a macrostructure of parallel sheets with hexagonal symmetry.)

In 1977, researchers in the Soviet Union found that deposition of the troublesome graphite could be prevented if excess atomic hydrogen were added to the reaction chamber. Hydrogen may both suppress formation of graphite nuclei and contribute to the creation of free radical sites. By 1981 the Russian scientists reported that they were able to form both single-crystal diamond films on diamond substrates and multiple diamond crystals on metal substrates.

The film industry runs fast-forward. With a solution to the graphite problem at hand, Japanese and other researchers began in the early 1980s to develop low-pressure CVD methods; these methods yielded high-quality single-crystal and polycrystalline films. With CVD, hydrogen gas is heated with a simple hydrocarbon compound such as methane (referred to in some of the popular accounts of the achievement as swamp gas, vodka, and sake) to temperatures of 2200°C. The carbon atoms are atomized and ionized and then rearrange and condense out onto the substrate. Diamond films made with CVD methods have proven to be both smoother and larger than those that could be made under high-pressure and high-temperature conditions.

In July of this year, scientists in the United States reported that isotopically pure diamond films (containing 99.9% carbon-12 and not the 1% carbon-13 that is present in natural diamonds) had been grown. The pure films not only conducted heat 50% better than the best natural diamonds but also withstood damage by laser radiation ten times more effectively than natural diamond.

Vapor deposition methodology now appears to be in an exponential phase of growth. Diamond films can be grown at pressures ranging from tens of torrs to 1 atmosphere. Film growth rates of 1 millimeter per hour are possible. Diverse volatilization methods have become available, including microwave discharges, hot filaments, plasma torches, and ion beams. The deposition of films at lower-than-normal temperatures (around 300°C instead of the standard 700 to 1100°C) has been accomplished through the addition of halogens to reaction mixtures; this is an important step if diamond is to be deposited on temperature-sensitive substrates. All of these variations on the basic CVD theme are making possible faster production of better materials with diverse morphologies.

For some purposes, diamond-like carbon films (which contain less than 1% hydrogen) or diamond-like hydrocarbon films (those with 20 to 60% hydrogen) may be as good or better than diamond films. In general, these films can be deposited at lower temperatures than can pure diamond films. The development of similar materials, such as the boron nitrides, may also benefit from the diamond technology boom.

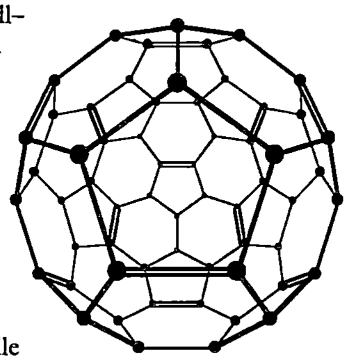
The many facets of diamond film technology. Much has been accomplished with CVD technology even in the absence of a clear understanding of how and why this process transmutes hydrocarbon into diamond. Experimental and theoretical approaches are now coming together to provide an understanding of the kinds of intermediates that form during the deposition process, the specific molecular species that promote the growth of the crystal lattice, the types of atoms that bind to the crystal's edges, the impurities (nitrogen, boron, and others) that disrupt the formation of diamond crystals, the ways in which reaction conditions affect the speed of film deposition and film thickness and shape, and the means by which specific properties of films enhance their usefulness for various applications. Most materials—metals, ceramics, plastics, polymers, and paper—are considered desirable substrates for some application of diamond films, and so an understanding of what promotes bonding is critical. For some applications, epitaxial growth is required, whereas in other cases the substrate serves only as a form on which a film is fabricated.

It has taken a quarter of a century for artificial diamond film production to get under way, but, now that it has, the future for diamond-based materials is likely to be a gem.

The Runners-up

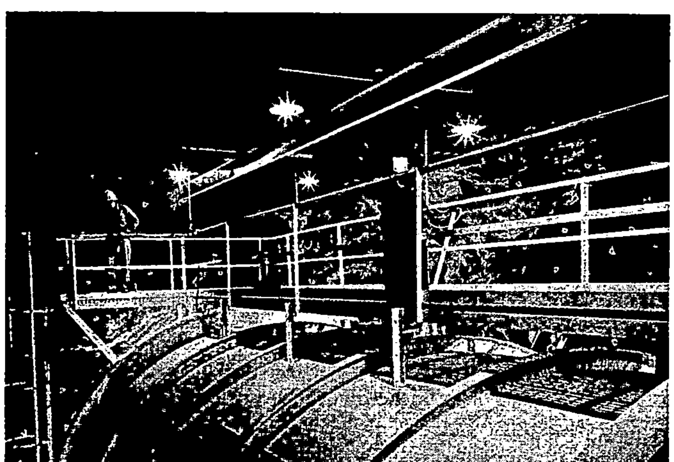
There were many scientific and technological developments in 1990 that had their own exceptional sparkle. *Science*'s top ten among these are described here.

Terrific tesselations. Distant cousins of diamonds, the 60-carbon buckminsterfullerenes or buckyballs, can now be synthesized in bulk. The availability of gram-per-day quantities of these soccer ball–shaped all-carbon molecules is a real kick for chemists: it has already made possible many analyses of the structure, spectral signature, and properties of C_{60} that had not been possible before. This handle on buckminsterfullerenes should also facilitate measurements of the abundance of C_{60} in the cosmos. Such clusters are incredibly stable and, because candle burning, wood burning, and star burning all create the conditions that favor formation of C_{60}, the buckminsterfullerenes may turn out to be among the most abundant molecules in the universe. Buckminsterfullerenes have been attracting attention for about 5 years, ever since they proved to be surprisingly abundant vaporization products in experiments directed at the production of long-chain carbon molecules. Why are the buckyballs so much more stable than other poly-carbon molecules? All members of the fullerene family are stable because they have no dangling bonds; C_{60} is the most stable of these complete hollow shells, perhaps because the way it curves minimizes stress on carbon-carbon bonds. The shape of the C_{60} molecule immediately brings to mind several possible applications—as catalytic surfaces and as capsules for transporting small molecules through the body, as do vesicles and viruses which have similar shapes. Unmodified buckyballs react poorly with other substances and may, like their precursor graphite, be effective lubricants; if their surfaces can be modified (for example, with hydrocarbon chains), new forms of organic molecules could be created on buckyball frameworks.



Juggled genes. Gene therapy is in theory the way to attack inherited defects head on: substitute a normal gene for one that is malfunctioning or missing. The first human gene therapy experiments have now surmounted all political hurdles and are under way at the National Institutes of Health; how quickly enough of the technologic challenges can be met to make this therapy effective remains to be seen. Can the good gene be targeted to the right place and, in some cases, can the defective gene be removed at the same time? Can the genetically engineered cells be kept alive and functioning, and can they be made to reproduce? Will enough of the needed gene product be produced? Can all this be done without activation of "innocent bystander" oncogenes inside the therapeutic cell? The genetic disease that was chosen for the prototype gene therapy trials is the immunodeficiency caused by an adenosine deaminase (ADA) deficiency. The disease would appear to be a perfect choice in which to evaluate and improve gene therapy technology. It is caused by a simple genetic deficiency—one enzyme is missing—and therefore might also be "simply" corrected. Although the disease affects perhaps no more than 50 people around the world, it is nonetheless widely known because of the poignant image projected by the "Boy in the Bubble." People born with an ADA deficiency cannot fight infectious diseases; they either live in a sterile (bubble) environment or are continually sick, and they die young from overwhelming infections. Cells carrying a functional gene for ADA have been given to the first few pioneer patients, but it is still too soon to evaluate the efficacy of these trials. Cystic fibrosis is also high on the gene therapy list; it is the most common fatal genetic disease in Caucasians in North America. Last year the gene that is responsible for cystic fibrosis was identified. This year, the faulty cystic fibrosis genes in two types of cells in culture were replaced with their normal counterparts; the substitution repaired defects in the cells' membrane ion channels, preventing the cells from swelling. It remains to be seen whether cells repaired in this fashion can reverse symptoms brought on by the build-up of dry mucus in the lungs of cystic fibrosis patients.

No-show neutrinos. Detection of solar neutrinos that are produced by fusion reactions in the sun's core is the only direct way to confirm that nuclear fusion is what causes the sun to shine. About 2% of the sun's energy is thought to be emitted as neutrinos; the rest as heat and light. The detection of solar neutrinos has not been a simple matter because they are low in energy, have no charge and little or no mass, move at the speed of light, and are not stopped by trivial barriers (like the earth). Nonetheless, for the past 23 years, the interactions of the higher energy solar neutrinos with an isotope of chlorine have been monitored in a vat at the Homestake Gold Mine in South Dakota. From these underground measurements, the "solar neutrino problem" has surfaced: only a third or a fourth of the number of neutrinos expected on the basis of standard solar models is detected. Is the shortfall due to a faulty detector, incorrect formulation of the physics of the sun, or a misunderstanding of

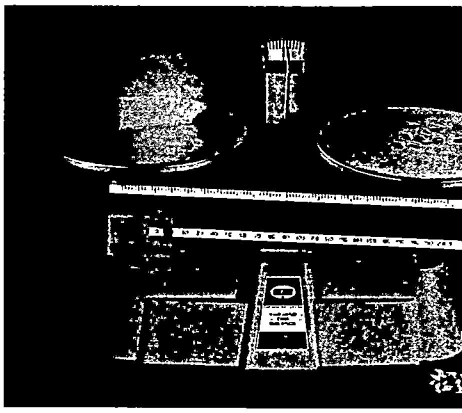


Brookhaven National Laboratory

neutrino physics? Last year the Japanese Kamiokande II detector confirmed the neutrino deficit; it also tracked the path of the neutrinos and showed that the neutrinos were indeed coming from the sun. This year, two gallium-based detectors (the joint Soviet-American SAGE detector and the Italian Gallex detector) are joining the search for solar neutrinos. The gallium detectors can detect lower energy neutrinos and thus should be able to monitor the vast majority of neutrinos coming from the sun, those produced by proton-proton fusions. Measures of the sun's brightness and of the neutrino flux should jibe; if they do not, and so far they have not, new neutrino physics will be in order. The new physics could include a mass for neutrinos and oscillations and transmutations between the three different types of neutrinos—electron, muon, and tau—while they are still inside the sun.

Alluring aerogels. Aerogels are strong, light, airy materials. The most airy aerogel prepared to date consists of 99.8% air; the rest is silicon dioxide. So far aerogels have been used only in high energy physics particle detectors. However, their properties—they do not conduct heat or sound well, they refract light, and they are almost transparent—have suggested uses for them as insulators in refrigerators, buildings, and windows. Half an inch of a silica aerogel can do what it takes $3^{1}/_{2}$ inches of a fiberglass insulator to do. Aerogels are being evaluated for use in space research to capture unharmed, fast-moving particles. The preparation of an aerogel begins with the preparation of a gelatinous polymer. High pressures combined with high temperatures are then used to remove the liquid from the gel in such a way that surface tension is not created: the fluid enters a supercritical state (gas and liquid are physically the same) and the gel does not collapse in on itself. Air moves in as the fluid moves out and what remains is an airy mesh, a kind of solid smoke.

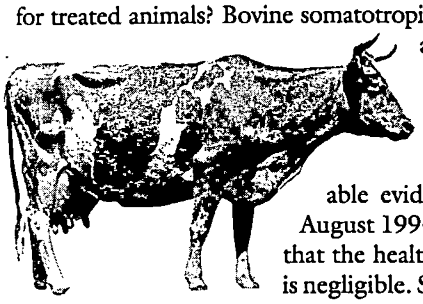
Lawrence Livermore National Laboratory



Powerful pills. Well over half a million Americans are currently taking the drug Prozac in order to control depression and other common psychological disorders, including anxiety, obsessive-compulsive behaviors, and bulimia. So far, Prozac is acting as something of a wonder drug; it is highly effective, causes few dangerous side effects, and is already the most widely prescribed antidepressant after just 4 years on the market. Prozac and earlier generations of drugs for depression (the tricyclics and the monoamine oxidase inhibitors) are not only changing the clinical outlook for depressed individuals but are providing valuable clues to the electrochemical circuitry of the brain and to how such circuitry might be modified in psychiatric diseases and in mental disorders. Depression has been associated with abnormally low activity of neurotransmitters, one of which, serotonin, appears to be Prozac's target. Normally, serotonin is released by a nerve cell, crosses a synapse to bind to a receptor on a second nerve cell, and then activates the second cell; later, serotonin is released by the second cell and is either degraded in the synaptic cleft or reabsorbed by the cell that originally secreted it. Prozac seems to block the reuptake of serotonin by the first cell. Because serotonin stays in the cleft longer, it also can work longer. Many pharmaceuticals besides Prozac have proved their worth in modulating neurologic functioning; two good examples are L-DOPA and Ritalin. Drug receptors can often be discovered with conventional biochemical techniques; thus, in addition to the therapy they provide, psychoactive drugs (like a range of imaging techniques) are of value for associating activity with architecture and are helping to map specific mental activities to specific regions of the brain.

Twinkling tweezers. Sperm that are too weak to penetrate the protective coat around an egg may soon be helped by laser beams. Femtosecond laser pulses can make tiny puncture holes in the egg's zona, thereby permeabilizing this protective layer so that the sperm can push their way through to the egg. Many advances in laser technology during the past 30 years have contributed to the production of the new precision lasers that act like mini-tweezers, mini-scissors, and mini-scalpels, catching, trapping, puncturing, cutting, and splicing subcellular structures and pushing or pulling them from place to place. The new laser tools have been used for a number of biomedical and biological projects—clipping off regions of chromosomes (followed by assessments of the consequences of the loss to the cell), cutting and splicing membranes, and moving organelles around inside cells. Chemists and physicists are using the advanced lasers to study molecular behavior by "pushing" molecules tiny distances within crystals; they have also harnessed the energy of lasers for splitting and ionizing molecules that participate in simple chemical reactions and have confirmed quantum mechanical predictions of simple reaction dynamics.

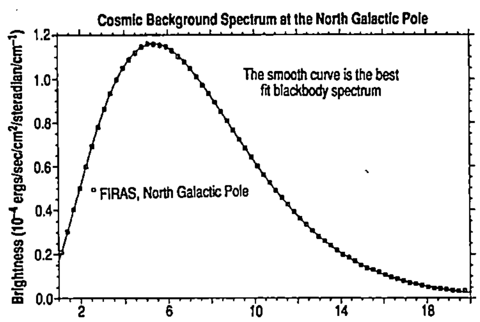
Growth industry. Everyone's favorite bacterium, *Escherichia coli*, is now churning out bovine growth hormone in quantities that put the pituitary glands of cows to shame. "Bovine somatotropin" is expected to be one of the next products of recombinant DNA technology to reach the marketplace; at the threshold, it is encountering a variety of obstacles. The hormone has powerful effects on lactation and can increase milk yields by as much as 25% per cow. Dairy lobbies in both the United States and Europe are troubled that the already precarious existence of small farmers will be further jeopardized if this new product is approved and large producers garner an even greater share of the market than they already control. Two states, Minnesota and Wisconsin, have for the time being banned the sale of the recombinant hormone; so has the European Parliament. There are also safety issues involved. Is the hormone safe for treated animals? Bovine somatotropin causes organ enlargement and lower reproductive rates in treated animals. Is there a possibility that the hormone will be dangerous to human consumers? Available evidence (published in the 24 August 1990 issue of *Science*) indicates that the health risk to human consumers is negligible. Sometime next year when all the data are in from multi-year animal-safety studies, the U.S. Food and Drug Administration will decide whether to approve the product for commercial use. Because of the continuing controversy, the National Institutes of Health also has convened a consensus panel to assess the animal and human safety of bovine somatotropin.



Gigantic gene. In July, the gene for type 1 neurofibromatosis or Von Recklinghausen disease was cloned. The disease affects about 1 person in 3000, so its incidence is less than that of cystic fibrosis or sickle cell anemia in American blacks. The most common signs are benign but extremely disfiguring tumors (called neurofibromas), cafe-au-lait (patchy) spots on the skin, and nodules on the iris. In a number of cases, learning disabilities, malignancies, and various neurologic manifestations also occur. The *NF-1* gene is huge and is thought to have as many as two million base pairs. At least three other genes are embedded in *NF-1*, piquing interest in whether these passenger genes have a role in the disease process. *NF-1* is highly conserved, which suggests that under normal conditions it may have some important cellular function. When the sequence of *NF-1* was compared with sequences of 20,000 other genes, striking homology was found with portions of two others. Current thinking is that the three homologs are tumor suppressor genes. Tumor suppressors keep cells from engaging in runaway proliferation, but when they are mutated their hold on the cell is broken and tumors can arise. The possible association of the *NF-1* gene product with tumor suppression has excited researchers studying all types of human cancers, because the molecular mechanisms that trigger Von Recklinghausen disease may be similar to those that initiate other human tumors.

Magical motifs. Molecular biologists have made significant progress this year in clarifying some of the complex interactions of protein and DNA molecules that result in gene activation. Differential gene transcription, the turning on and off of specific genes, is what ensures that, for example, a developing heart cell will in fact grow and differentiate into a heart cell despite the presence of all the genes necessary to make it a liver or stomach cell. Although many different types of transcription factors have been identified and studied in both simple and complex organisms, structural studies now indicate that the factors can be sorted into just a few categories on the basis of their conformations. Two distinct "motifs" are prevalent among the many transcription factors and appear to mediate the formation of dimers that then bind to DNA. One motif is the leucine zipper; the other is a helix-loop-helix arrangement. Both are typically situated close to highly positively charged regions of amino acids that interact with negatively charged DNA. "Partnering" has recently been observed to occur between dissimilar transcription factors. This increases the diversity of transcriptional activating complexes that can be generated within a cell. Thus, from a relatively small number of transcription factors, many distinctive dimers can form; each can have a new specificity, new binding affinity, and new effect on gene expression.

Cosmic questions. The field of cosmology, which has long been rich in theory, is now growing rich in data as well. A striking example of the new wealth is the data returned this year by the Cosmic Background Explorer satellite (COBE), which was launched by the National Aeronautics and Space Administration in November 1989. COBE is examining the "afterglow" of the Big Bang—the photons that were emitted within a few hundred thousand years of the event. Ground-based observations of the cosmic background radiation have shown it to be homogeneously distributed; in COBE's first few minutes of observation, its infrared absolute spectrophotometer confirmed at high resolution that the spectral signature of the afterglow was that of a perfect black body. The COBE measurements are addressing two related cosmologic mysteries: why is the cosmos, overall, so homogeneous, and how did structure (stars, galaxies, clusters, superclusters) evolve out of the smooth background? The COBE instruments continue the search for the tiny seeds of inhomogeneity that are thought to be the foci around which the first stars would have formed; within a few months, these measurements should reach a level of resolution of one part in 10^5. When the expected fluctuations are found, existing theories that account for the appearance of structure will need some refinement. If the fluctuations do not appear, theorists will be back at square one looking for new energy sources to invoke along with the Big Bang to account for the formation of the universe.



■ Ruth Levy Guyer and Daniel E. Koshland, Jr.

SCIENCE

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The Molecule of the Year

Historians tend to personalize history. They use political leaders to symbolize war or peace, freedom or slavery, abundance or starvation. Political systems represented by these individuals may be essential, but political leaders cannot cure disease without medicine, cannot improve crops without fertilizer, and cannot encourage the literacy on which democracy depends without communications technology. The great advances of the past have been profoundly influenced by science and technology, and our present standard of living depends on them. Political systems can be designed to encourage advances in science and are essential to the fair distribution of its products. Wealth must be created before it can be distributed.

Sometimes, in the rush of daily events and the ease of describing personalities instead of analyzing issues, the fundamental causes of progress can be obscured. To symbolize that scientific progress and to honor the structure that creates it, *Science* has decided to name a Molecule of the Year. The molecule will symbolize a discovery or technique that may actually involve many molecules, but the award will be singular to force us to choose one such discovery each year that is likely to have the greatest influence on history. We will not require that the initial discovery has to be made in the year of the award because many discoveries are not recognized immediately or require refinement for optimum value. The award will, however, reflect the fact that the particular discovery has reached in the year of the award a stage of development and understanding sufficient to establish its long-term significance.

This year's award goes to the DNA polymerase molecule and to the technique called polymerase chain reaction. PCR, as it is called, has developed into one of the most powerful tools of modern biology since its discovery several years ago, and its applications are burgeoning. One of its first applications allowed an Indian mother to establish the identity of her son for immigration purposes. It has this year served as the basis for making human antibodies in a bacterium. It is revolutionizing the approaches researchers are taking to many problems in biology. Other properties and potentials of PCR are discussed in the section that follows, as are many other discoveries that could easily have been chosen in a year that has seen major advances of science in almost every discipline.

Some who look into the mirror darkly see the waste disposal problem and forget the great numbers of people alive today, see the pesticide problem and forget the availability of food to many, or see the acid rain problem and forget the popularity of the automobile. Each widely adopted technical advance generates new problems that themselves cry out for technical solutions. The problems are real. So, is this progress?

To answer that question I propose a simple objective test: the era swap experiment. Each person could choose to be transported back to some previous time but only on condition that he or she adopt all the features and restrictions of that era. In the 1800s, for example, the globe was less crowded, the air was clearer, the water cleaner, and there were no plastics. However, life expectancy was half of what it is today, transportation was by horseback or on foot, and medical operations were performed without anesthetics. Even a few years ago a high proportion of women died in childbirth, and pneumonia was one of the major causes of death for middle-aged people. Faced with such realities, who would choose to live even a few years in the past?

Our Molecule of the Year is a symbol that we are honoring the process of progress rather than a personality. Most of the discoveries of science (and probably much of political history) result from the actions of many individuals, one of whom may contribute slightly more than others. Each person who moves the discovery one step further contributes to the benefit of all. Science is an international enterprise; its practitioners and those who benefit from the knowledge it creates are located throughout the world. The new knowledge—which translates into living standards—can be used for good or evil, can be distributed fairly or unfairly. The challenge to science is to generate the new discoveries. The challenge to society is to use those discoveries for the betterment of all.—DANIEL E. KOSHLAND, JR.

The Molecule of the Year

RUTH LEVY GUYER AND
DANIEL E. KOSHLAND, JR.

Science HAS SELECTED THE POLYMERASE CHAIN REACTION AS the major scientific development of 1989 and has chosen for its first "Molecule of the Year" the DNA polymerase molecule that drives the reaction. The list from which the polymerase chain reaction (PCR) was chosen included an impressive array of accomplishments in many areas of science and technology; additional kudos are therefore conferred below to 17 of the other big "stories" that made 1989 an exciting year for scientists and for followers and beneficiaries of science. Although the PCR procedure was introduced several years ago, use of the technique truly burgeoned in 1989; in much the same way, the full potentials of many of the interesting "runner-up" scientific achievements of this year are likely to be realized sometime in the years to come.

The first PCR papers were published in 1985. Since that time PCR has grown into an increasingly powerful, versatile, and useful technique. The PCR "explosion" of 1989 can be seen as the result of a combination of improvements in and optimization of the methodology, introduction of new variations on the basic PCR theme, and growing awareness by scientists of what PCR has to offer. With PCR, tiny bits of embedded, often hidden, genetic information can be amplified into large quantities of accessible, identifiable, and analyzable material. A single cell provides enough material for analysis; a single hair can be used to identify an individual.

The basic PCR reaction. The starting material for PCR, the "target sequence," is a gene or segment of DNA. In a matter of hours, this target sequence can be amplified a millionfold. How this is accomplished is shown in the accompanying figure. The complementary strands of a double-stranded molecule of DNA are separated by heating. Two small pieces of synthetic DNA, each complementing a specific sequence at one end of the target sequence, serve as primers. Each primer binds to its complementary sequence. Polymerases start at each primer and copy the sequence of that strand. Within a short time, exact replicas of the target sequence have been produced. In subsequent cycles, double-stranded molecules of both the original DNA and the copies are separated; primers bind again to complementary sequences and the polymerase replicates them. At the end of many cycles, the pool is greatly enriched in the small pieces of DNA that have the target sequences, and this amplified genetic information is then available for further analysis.

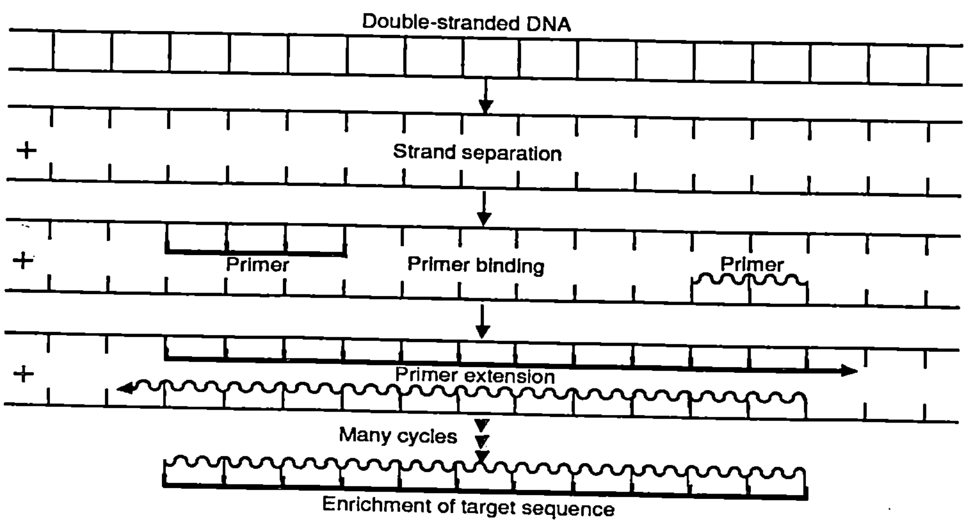
Evolving PCR. Many improvements on the original PCR method have been made. One of the first was the substitution of a heat-stable enzyme for the original DNA polymerase, which was heat-labile and had to be replenished after each cycle. The stable "Taq polymerase," which comes from bacteria that live in hot springs, continues working almost indefinitely despite the heating steps. Taq polymerase improved the yield, generated more specific and longer products, and facilitated automation.

New strategies have also been devised for flanking unknown sequences with defined primer sites. For standard PCR, the sequences at both ends of a target sequence have to be known. "Inverse" PCR provides a way of sequencing DNA outside the primer sites rather than between two primer sites. Primer molecules are synthesized with their sequences reversed. The target DNA is cut and circularized, and, when the polymerase extends the primer, it does so around the circle in the direction opposite that which would have been taken by standard PCR primers. "Anchored" PCR was developed for studying genes that encode proteins for which partial sequences are known. For anchored PCR, only one defined primer sequence is needed, not two.

The implications of inverse and anchored PCR for DNA sequencing are astounding: enormous stretches of DNA can be sequenced once a tiny bit of sequence is known. Both techniques make it possible to proceed along the DNA, continually redefining "ends" to which synthetic primers can be bound and then extended.

Applications of PCR. The basic PCR procedure has been valuable in disease diagnosis because specific DNA sequences can be amplified enormously (the needle in the haystack). One of the first uses led to improved diagnosis of a genetic disease (sickle cell anemia), because the PCR technique depended on much less clinical material than standard procedures. (Because PCR is exquisitely sensitive, unusual care is taken to avoid the amplification of contaminants.) PCR can also be used to amplify trace amounts of genetic material of infectious agents in blood, cells, water, food, and other clinical and environmental samples. PCR-based tests are especially valuable for detecting pathogens that are difficult or impossible to culture, such as the agents of Lyme disease and AIDS. For cancer diagnosis and cancer research, PCR can indicate what genes are expressed or turned off, because the messenger RNA molecules associated with such genes can be converted into complementary DNA sequences that then can be amplified.

DNA samples in trace materials (semen,



blood, hairs) found at the scene of a crime have been compared with DNA samples from crime suspects; both acquittals and convictions have resulted from such comparisons. Missing persons have also been positively identified through PCR-based comparisons. The resolution of paternity cases has been aided by comparing DNA from a child with that of the alleged father. And matches of transplant donors and recipients are facilitated with PCR. "Universal" primers are being used to determine the extent of homology in the sequences of conserved genes from different samples. Such comparisons, which help to establish evolutionary relations among organisms, can even include extinct organisms, because DNA samples extracted from mummies, bones, and other archival materials can be used.

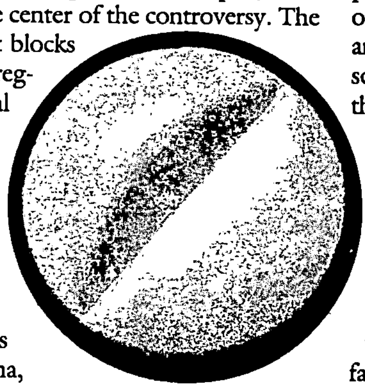
PCR may soon replace gene cloning as the amplification method of choice for gene sequencing, for which large amounts of DNA are needed. PCR is also providing new options in molecular genetics studies for adding genetic information to target materials or for altering what is already there.

The rate at which new PCR-based techniques have been developed suggests that this technology is proliferating as rapidly as its Taq polymerase molecules replicate target sequences.

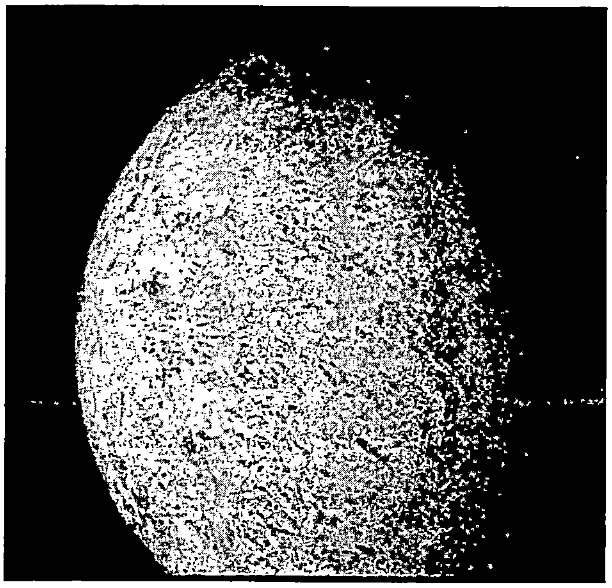
Other major scientific developments of 1989. The choice of the PCR polymerase as the Molecule of the Year was not a simple one because 1989 saw major developments in many areas of science and technology. Some of these advances are the first steps to what may develop into major discoveries but were "runners-up" because their full applicability is not yet known. Some represent steady progress, but not breakthroughs, in fields of major importance. Listed here are the scientific developments of this year that, because of their great potential, were close competitors of PCR.

Most mind-boggling synthesis. The correct synthesis of the compound palytoxin, which has one sextillion (10^{21}) possible isomers, was a major triumph of synthetic organic chemistry. Palytoxin has the chemical formula $C_{129}H_{223}N_3O_{54}$; it has been described as a substance that gives "new meaning to the word macromolecule." Natural palytoxin is extracted from coral and is a potent toxin that once was used for poisoning spear tips. Its only known source—coral that live in a 6 foot by 2 foot tidepool near Hana, Maui—proved difficult to discover, because local lore had it that those who collected palytoxin were cursed. The curse apparently did not apply to chemists: 8 years of strategic planning and experimental work culminated this year in the correct synthesis of this complex compound. The mammoth project has yielded many new procedures and strategies that can be applied to other difficult organic syntheses.

Most controversial. One world problem whose solution could solve many others is overpopulation. So the availability this year of RU 486, a pill that is effective at halting gestation and thereby at terminating pregnancies, has caused great excitement. RU 486 also may be one of the most controversial drugs ever developed, with politics and ethics, not efficacy, at the center of the controversy. The pill is a steroid hormone analog that blocks the action of progesterone during pregnancy. Since progesterone is essential both for establishing and sustaining a pregnancy, blockage by RU 486 causes miscarriage. In developing countries, some 200,000 women die each year from bungled abortions, and, for them, an antigestation pill would be lifesaving. (At present, however, RU 486 is available only in France and China, thus raising the spector of a black market in RU 486 sales.) The full potential of RU 486 is only hinted at by available studies: in addition to terminating pregnancies, it facilitates problem deliveries, and its steroid-like actions may be effective in the treatment of certain types of cancer, Cushing's disease (which is characterized by excess cortisone production), wound healing, and glaucoma.



Most universal appeal. The year 1989 was a banner one for space exploration. The "Planet of the Year" was clearly Neptune and the "Spacecraft of the Decade" was clearly Voyager 2. On 24 August, Voyager's Neptune flyby capped a more than 10-billion-kilometer Grand Tour of the solar system, and the final sets of dazzling images



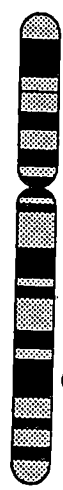
of planets, moons, and rings (of a total of 100,000 sent altogether) and bits of data (of 5 trillion sent) were beamed back to Earth. The Voyager mission, which included two Voyager spacecraft, began in 1977 and has been an unmitigated success. Voyager 1 visited Jupiter and Saturn; Voyager 2 visited the Jupiter, Saturn, Uranus, and Neptune systems. Of the outer planets only Pluto was not in the right place at the right time for a flyby. Another space highlight of the year was the Soviet Phobos mission, which provided new information about Mars before contact with Earth was lost. And two important missions were begun: the Magellan spacecraft set out for a 1990 encounter with Venus, and the Gallileo spacecraft left for Jupiter, which it should reach in 1995.

Most likely to succeed. Various technologic advances have, over the years, made possible the preparation of pure populations of highly specific antibody molecules; such antibodies bind to target substances (antigens) and have many uses in vivo and in clinical and laboratory tests. The latest advance, which was made this year, is likely to revolutionize the antibody industry: it involves antibody production by genetically engineered bacteria. A complete "library" of antibody genes from an animal can be introduced into bacteria and the binding regions of antibodies produced. The antibodies are screened for the desired specific reactivities. The appropriate gene is then amplified and antibodies churned out in quantity, and it is a comparatively easy job to screen a million molecules a day. This procedure may generate antibodies with higher affinities than those induced in animals; immunization is not necessary, and therefore difficult immunizations—for example, where the appropriate antigen is not known or is toxic—no longer present a problem. This system should be useful for producing antibodies that catalyze enzyme reactions, that bind to target antigens in vivo or in diagnostic tests, that function as biosensors, and that facilitate clinical and basic research.

Most absorbing. The ability of scientists and engineers to depart from and improve upon what nature has to offer is not unique to the biological sciences but has also been a goal of materials science research. The 1990s have in fact been designated by the National Research Council as the "Age of Materials." Many novel materials that are lighter, stronger, or harder than known substances or have other exceptional features have been fashioned by materials scientists by combining molecules and atoms in new and different ways. An interesting example that was unveiled in 1989 was Stealth technology; the goal of this technology is to evade radar detection, and the B2 Stealth bombers absorb, rather than reflect, radar signals. Along with the advanced materials, advanced methods for fabricating them, such as molecular beam epitaxy and laser vapor deposition, came into wide use this year.

Best supporting actor. An extremely potent new immunosuppressive drug, FK506, was made available this year for experimental and clinical use. Immunosuppression is crucial to the success of tissue and organ transplants but, until now, only cyclosporin A has been widely used for suppressing the immune system. FK506 and cyclosporin A have entirely different structures; therefore, it was surprising that their actions were much the same. Each binds to an abundant (but different) protein inside target cells. Each inhibits the enzymatic activity of the target protein. The two target proteins appear to have the same enzymatic activity and to influence the folding of cellular proteins, the transduction of signals in cells, and the activation of certain lymphocytic cells. Comparisons of the actions of these two different immunosuppressors may assist in sorting out the molecular events that work together to bring about immunosuppression.

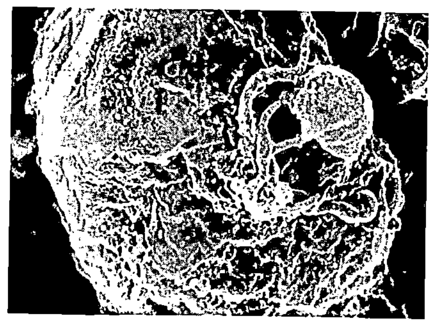
Most refreshing. September brought some long-awaited good news for individuals with cystic fibrosis (CF) and CF carriers: the CF gene was identified. There is no animal model for this disease, and the identification of the gene was an important milestone in CF research. In CF, the lungs, the pancreas, and the sweat glands all malfunction; a thick mucus clogs the lungs and this promotes opportunistic infections that destroy lung tissue; affected individuals usually die before they reach the age of 30. The identification of the CF gene is expected to have immediate payoffs in screening for carriers of the gene, in prenatal diagnosis, and for developing therapies based on improved understanding of the consequences of the genetic defect. The predicted sequence of the protein product of the CF gene has been helpful in suggesting a function for this protein in normal individuals and the nature of the aberration in affected individuals.



CF

Most penetrating. Although the scanning tunneling microscope (STM) was developed some years ago, widespread use of this technology really began in 1989. STM provides atomic-scale information about surface topography. Images of a surface's atomic peaks and valleys are generated as a probe moves along the contours; electrons jump from the scanning probe to the surface, tunneling into "forbidden" areas, when an electric field is applied. The atomic structures and electronic properties of semiconductors, high-temperature superconductors, and biologic molecules in air and under water are now being almost routinely determined by STM and its offshoot, atomic force microscopy. A recent innovation involves the use of the sharp tip of the scanner for drawing lines on and punching holes in the surfaces of crystals; this application of the instruments for a purpose other than scanning and tunneling surfaces may make it possible to generate nanometer-size patterns on electronic devices.

Most scrutinized disease. AIDS continues to be elusive, but this year some headway may have been made both in treatment and in vaccine development. The search for effective drugs for treating AIDS patients has intensified recently as the efficacy of AZT, the only currently approved AIDS drug, has begun to wane. AZT often works well for many months; but after about 6 months, AIDS viruses begin showing reduced susceptibility to the drug, and by 18 months the drug's clinical value is sharply reduced. In early summer, the drug ddI passed muster in preliminary clinical trials designed to determine its toxicity. A group of AIDS patients, some of whom could not tolerate AZT, tolerated this purine analog for a period of 42 weeks and had increased energy levels and some improved immune functioning. This month the possibility was raised that protective immunity against AIDS might be induced with a vaccine: in a monkey model, vaccination against a simian immunodeficiency virus prevented AIDS-like disease when the macaques were later challenged with lethal viruses. The study raised the possibility that protection might be achieved even if infection was not entirely prevented.



Most fundamental. Physicists are no longer losing sleep trying to generate enough Zs. Z^0 bosons are the vectors of the weak nuclear force. The standard model of high-energy physics posits that all elementary particles are members of distinct but parallel families. Physicists have long thought that the number of such families is three, but, in theory, more families are possible. This year at the Stanford Linear Accelerator Center, the CERN European Center for Particle Physics, and the Fermi National Accelerator Laboratory, Z^0 bosons were for the first time produced in quantities that were sufficient for analyzing particle masses and lifetimes. The results from CERN and Stanford have narrowed the family number to three, thus bolstering the validity of the standard model as well as the validity of the Big Bang theory for the origin of matter.

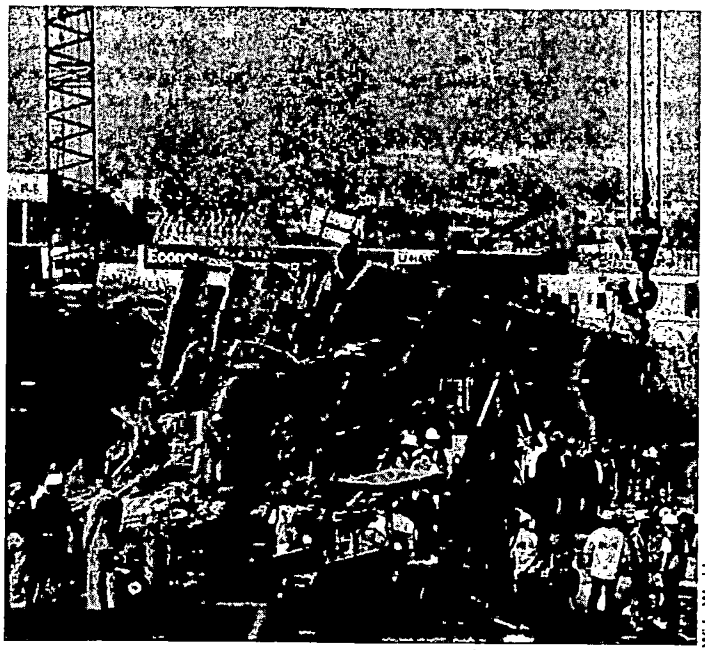
Most heated discussion. The condition of the global environment, both present and future, was one of the biggest scientific topics last year, and still at issue this year are many of the same questions. Has global warming from greenhouse gases been detected, when might larger changes occur, and what should be done about the situation? New measurements of the depletion of ozone in the atmosphere and the expansion of the ozone hole suggest that ozone losses are occurring outside the hole, although the specific mechanisms of this type of loss are unclear. Clouds continue to be of interest because of their role in the earth's energy budget and because of the part played by polar stratospheric clouds in chemical reactions that lead to ozone depletion. Global climate models, which are undergoing steady improvement and have been used more and more, should figure into the future environment-related decisions and actions of the international community.

Most productive. In June, a genetically engineered kidney hormone was approved for use by the U.S. Food and Drug Administration. This could turn out to be one of the biotechnology industry's big commercial medical successes. Erythropoietin, known by the trade name Epogen, stimulates the production of red blood cells. In normal individuals, the natural hormone is instrumental in replenishing the billion or more red blood cells that turn over each day; in patients with kidney failure (of whom there are 95,000 in the United States), there is a tremendous red blood cell deficit. These patients typically receive regular post-dialysis transfusions, because dialysis leaves them weak and anemic. However, with injections of Epogen, red blood cell production resumes, the patients are energized, and the need for transfusions is obviated. (Patients with AIDS and certain cancers might also benefit from the boost to red blood cell production provided by Epogen.) If, like Epogen, other blood products can be made commercially by genetic engineering procedures, reliance on transfusions might be lessened and the incidence of transfusion-associated cases of AIDS and hepatitis could be lowered. Already in the commercial pipeline are other blood products like factor VIII.

Most original. RNA molecules, which once were thought to be the middlemen in the process by which proteins were made from DNA, have come into their own. RNA can cut, splice, and assemble RNA sequences without help from any other types of molecules. It is now clear that in RNA-protein complexes, the RNA segments do the catalytic work while some of their partner proteins serve mainly in structural capacities. Thus it may eventually be possible to block gene expression inside cells or interfere with virus infections through the use of catalytic RNA molecules. It is also becoming clear how transfer RNA molecules, which take amino acids to the ribosome where they are added to growing protein chains, get properly "charged" by synthetase enzymes. The discovery that RNA can be self-sufficient lends support to the hypothesis that the most primitive biotic world was an RNA-based world; it was into this world that proteins came only later to specialize in some of the activities that RNA could already do.

Most tantalizing. If one science news event most excited the imaginations of the scientific community, the public, and the press it was certainly the claim in March of the achievement of cold nuclear fusion in a jar. The prospect that a plentiful and cheap energy supply might become available for an energy-hungry world engendered great interest and excitement. As soon as the claim was made, laboratories all over the world scrambled to repeat the experiment, apparently to no avail. Yet some still believe something intriguing is going on in those jars, although what it is continues to elude explanation. Investigations of cold fusion continue but at lower energy levels.

Most earthshaking. For some time, structural engineers in California have been devising ways to shore up structures against earthquakes, and a test of their work came this year. On 17 October 1989, an earthquake with a mainshock magnitude close to 7 rocked the San Francisco Bay Area. In the city's hard-hit Marina district, artificial fill amplified the waves of the earthquake, and many buildings were destroyed. Elsewhere the extent of damage varied, and altogether fewer than 100 people were killed. The experience pointed up the importance of reinforcing older structures and of attending closely to new building design and city planning (on what types of soil should buildings be built?). These are currently the best defensive actions that can be taken against earthquakes, because consistently accurate short-term predictions of earthquakes are still a long way off. Earth scientists have been gaining new insights into dynamic features of the mantle and core through seismologic and experimental studies (in particular, through use of the diamond anvil cell) and



Wide World

theoretical considerations. New microanalytic techniques have increased understanding of reaction mechanisms and processes in the earth, have improved dating accuracy, and should soon provide data on isotopic compositions of individual mineral grains.

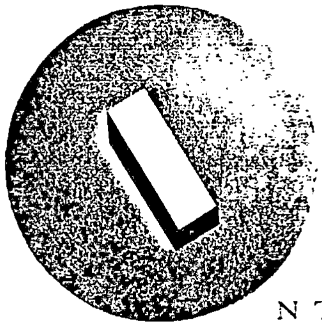
Most antithetical pair. There is increasing understanding of the types of genes that contribute to the development of cancer and how they do it. A fruitful new approach for cancer therapy may someday involve intervention in the expression or loss of expression of cancer-associated genes. Two functionally opposite types of genes, both active in normal cells, play a part in tumor development. Oncogenes are cellular genes that affect normal growth, development, and the transduction of signals in cells; disruption of the normal functioning of oncogenes (for example, when they are picked up by tumor viruses or acted on by carcinogens) leads to abnormal growth of cells and the development of cancer. Other genes, the tumor suppressor genes, act in a very different manner. They normally block tumor development and drive cells toward normality, but, when specific mutations accumulate in a cell or when tumor suppressor gene functions are lost, cancers can arise. The balance struck between oncogenes and tumor suppressor genes appears key to whether cell behavior will be normal or aberrant.

Most thought-provoking. Can a machine be taught to think like a human? And, if the workings of the machine can be delineated, will the workings of the human mind also become clear? These twin questions are at the center of neural network, or connectionism, research, a fiercely competitive interdisciplinary field (combining electrical engineering, neurophysiology, physics, behavioral psychology, and others) that has gained new momentum in the past 2 years. (For example, the United States is reported to have close to 3000 researchers already working in this area, Japan has several hundred, and the European Economic Community has 1000.) Learning algorithms are being designed, circuits are being wired up like neurons in the brain (each usually with many inputs but only one output), and machines are learning such skills as how to pronounce previously unencountered English words and how to calculate the curvature of an image from its shading patterns. The commercial potential of robots that can write, speak, and in other ways interact with their environments appears to be limitless; what insights such machines will provide about how thinking occurs remains to be seen.

The United States showed the world how a government could foster the freedom required for basic science research, the results of which can be negligible or earthshaking. That freedom—and America's technological lead—have eroded at the same time

MANAGING THE UNMANAGEABLE

BY ROBERT P. CREASE AND NICHOLAS P. SAMIOS



IN THE FALL OF 1942 J. ROBERT OPpenheimer walked into the Presidio, in San Francisco, to undergo a physical. He was about to be tapped by General Leslie Groves, the head of a top-secret Army project, to establish and administer a classified laboratory in Los Alamos, New Mexico, that would investigate the possibility of developing an atomic bomb. Oppenheimer and his bosses took it for granted, given the source of the money, the lab's directive, and the need for security, that the facility would follow conventional practice and be militarized. Hence his trip to the Presidio; the physical would be the first step toward being commissioned a lieutenant colonel, which in turn would be the first step toward taking command of the largest and most ambitious scientific project yet attempted.

But Oppenheimer never went through officer training. He never needed to. Key scientists refused to come to Los Alamos under conditions of military hierarchy and bureaucracy, which, they said, were antithetical to the spirit of science. Scientists thrived when they were judged according to competence, not rank. Under pressure, Groves relented. On February 25, 1943, he sent Oppenheimer a letter promising that although the military would provide resources and general direction, for at least the time being Los Alamos would remain civilian, managed by contract with the University of California. Even Groves would come to recognize that this arrangement worked far more effectively than the original, conventional one would have.

The letter set a momentous precedent for relations between the U.S. government and its scientists. When, after the war, the newly founded Atomic Energy Commission set up a string of national laboratories, it chose to manage them according to a similar scheme, called administrative contracting, in which independent managers were hired, often universities or similar nonprofit organizations. The system was viewed as essential to the special environment needed for basic research, which, unlike applied research, seeks an understanding of the structures of nature for its own sake. Partly as a result, the United States forged ahead of other nations in postwar science and in the technology that derived from it.

Today that innovative and unique system is in jeopardy, threatened by a tendency to manage federal undertakings of all kinds, including scientific projects, as though they were businesses—constrained by business procedures and requirements and responsive to business incentives and pressures. Although we will focus on the problems of the national laboratories, owing to our familiarity with them, we believe that similar management problems are or soon will be experienced in connection with large government-sponsored scientific projects in other branches of science. The impact on science has gone virtually unnoticed by the public, because it has occurred in a series of tiny steps, no single one of which has been large enough to attract attention. But it is oppressively evident to those who work inside the national laboratories. The attempt to treat basic research as a business has slowly changed the structure and spirit of these laboratories, and begun to strip away the special protection this country once accorded them and to taint the fragile atmosphere needed for them to thrive. At a time of widespread lamentations about the loss of U.S. technological competitiveness, it is ironic that we are destroying one of the most important means by which we established that technological competitiveness in the first place.

Changing the World by Chance

Although basic and applied research are often intertwined in practice, their intellectual missions are distinct. Basic research aims to recognize previously unknown structures of nature, whereas applied research aims to make some already known process possible or more effective. The structures of nature recognized in basic research may have practical applications, but whether they do or not, and if so of what type, are generally not the professional concern of the basic researcher. At the beginning of this century a popular postprandial toast around the Cavendish Laboratory of Cambridge University, in England, was, "The electron: may it never be of any use to anybody!" That wish, as the physicist Abraham Pais once wryly remarked, was unfulfilled. A few decades earlier, during an inspection of the Royal Institution, in London, a skeptical William Gladstone questioned the potential value of electricity. "Sir," came the waggish riposte, "someday you will tax it!"

The American sociologist Robert Merton once devoted an essay to what he called "the unanticipated consequences of purposive social action." Human action, he wrote, often brings about processes or results that are unintended by the actors, and these can affect either the actors or society as a whole, and can be beneficial or not. Although Merton was specifically discussing social action, his point is equally true of scientific research. But whereas most human action seeks to avoid unanticipated consequences, basic research courts them. Many discoveries are unsurprising, expected outcomes of deliberate research programs. Nevertheless, basic researchers are always aware of the possibility of—and often hope for—novel developments. The British theoretical physicist P.A.M. Dirac, who devised the "Dirac equation," which accounts in a comprehensive way for the behavior of the electron, used to say that his equation was smarter than he was, because it contained solutions to problems of which he was unaware. Moreover, historical illustrations of unintended practical consequences of discoveries are legion. We will cite a few examples to illustrate the mundanity of unforeseen consequences in discoveries of genuinely new structures of nature.

Improving medical techniques was hardly on the mind of the German physicist Wilhelm Roentgen as he tinkered with cathode-ray tubes in November of 1895. But when he explored the curious fact that a fluorescent screen near his apparatus was glowing, contrary to all expectations, he ended up discovering a wholly new phenomenon of nature, which he called x-rays. Within three months they had been used to examine bone fractures. His discovery triggered a series of other important scientific discoveries, such as that of radioactivity.

"I don't think the idea of helping suffering humanity ever entered our minds," Howard Florey, of Oxford's Dunn School of Pathology, once recalled of the moment in the late 1930s when he and his colleague Ernest Chain began a survey of antibacterial mechanisms. But on their list of microbes to study was penicillin, which had been discovered accidentally only a few years before but whose antibacterial properties had been neglected. Much of modern medicine is based on a substance whose discovery and development were matters of sheer chance and disinterested academic research.

"Moonshine," responded the British scientist Ernst Rutherford, who discovered the nucleus in 1911, to the suggestion that energy might be obtained from it. Atomic energy was equally far from the thoughts of the Italian physicist Enrico Fermi when, in 1934, he began bombarding the nuclei of all known elements with neutrons, and was puzzled by the results he achieved with the heaviest known element, uranium. The German scientists Otto Hahn and Fritz Strassmann were trying to make sense of Fermi's odd results when, at the end of 1938, they announced that barium was a by-product of such bombardments. A month later two other German researchers, Otto Frisch and Lise Meitner, were only trying to explain *that* puzzling result when they suggested that uranium nuclei could split, or "fission," with a concomitant release of energy. The outcome of all this puzzle-solving, it hardly needs mentioning, transformed the world.

The unintended consequences of scientific research can reach far beyond science and technology, to have a cultural impact as well. One remarkable and well-documented example is the profound effect that telescopic astronomy had on Milton's poetry, and in particular on his imaginative depiction of the space of the universe in *Paradise Lost.* Some three hundred years later one might consider how x-rays, CAT scans, and radio telescopes have further altered human perception and imagination. It is unfortunate that the beneficial effects of scientific discoveries often become so thoroughly integrated into the world that they are taken for granted, as part of its warp and woof, whereas the pernicious applications of scientific discoveries are often portrayed as representative of scientific activity itself. Pessimists anticipate that basic research will deliver new forms of power to be socially abused; optimists anticipate a reform of social structures which will eliminate such abuses.

Temperamentally, scientists tend to be optimists, and if pressed will defend their work by saying that in the long run, at least, the effects of science are beneficial. But arguments about the value of basic research that are based on anticipations of either social utility or harm are weak, because they are based on analogy: the future will be like the past. A deeper motive for basic research is that it ultimately leads not just to understanding of the structure of nature but to self-understanding as well. What is nature? and Who are we? are not distinguishable questions. "Whatever nature has in store for mankind, unpleasant as it may be," Fermi once said, "men must accept, for ignorance is never better than knowledge."

An Odd System That Worked

THE PHRASE "MANAGING BASIC SCIENCE" MIGHT at first seem oxymoronic, like the oft-repeated jest about "military intelligence." Management is the effective coordination of resources and personnel toward a particular end; how can one coordinate an activity whose end is unforeseen and unforeseeable? Nevertheless, basic science stagnates when it is not effectively supervised. Salaries of basic scientists, for instance, are lower than those of applied scientists. Basic scientists cannot be paid competitive salaries, because there is no guarantee that their work is marketable; and even when it eventually happens to be so, the returns are usually too far in the future to affect them. Nevertheless, many extremely bright people find that the relative freedom to follow one's nose in preparing a research program, collaborating and competing with smart and dedicated colleagues, and the thrill of the prospect of making fundamental discoveries are ample compensation for unequal pay.

> BASIC RESEARCH FLOURISHES WHEN IT IS VIEWED NOT AS A PROFIT-MAKING VENTURE OR AS AN INSTRUMENT OF SOCIAL CHANGE BUT AS AN EXPLORATION OF NATURE.

Creating and maintaining a healthy scientific culture is the aim of science management, and it involves tending to both the intellectual and the institutional conditions of basic research. The intellectual condition is freedom of inquiry—allowing and even encouraging scientists to follow new paths should they open up, to risk dead ends, to shift direction abruptly on a hunch. The institutional condition of basic science is a laboratory environment that facilitates such freedom of inquiry. A laboratory is more than a collection of equipment and the space to house it. It is a theater in which experiments are performed and witnessed, and like theaters of the more familiar kind, it is specially built for that purpose. Providing such environments was less complicated in the first few decades of this century, when scientists worked alone or in groups of twos and threes, when important laboratory skills were glassblowing and carpentry, and when one required no more than an ordinary room in which to perform an experiment. At that time laboratory equipment was workbench-sized and relatively inexpensive, and much of it was built by the researchers themselves; until the 1930s the first morning task for a physicist who needed power supplies often was to build batteries. With the Manhattan Project and the postwar establishment of the national laboratory system, however, all that changed. "Little Science" became "Big Science," in the words of Alvin Weinberg, a former director of Oak Ridge National Laboratory, in Tennessee. Researchers might work in teams not of twos or threes but of dozens and even hundreds; the cost of experiments reached not tens of thousands but hundreds of millions of dollars. Making equipment was subcontracted to industry, and the space to house it might require hangar-sized buildings.

Today Weinberg's phrase is unfortunately associated with an unproductive debate about science funding policy in which "Big Science" often carries connotations similar to those of "Big Business." The suggestion is that large scientific projects unfairly monopolize scientific capital, squeezing out the little guy who might make valuable innovations if given a chance. But the analogy is false. Knowledge generated by large scientific projects, unlike the profits of large corporations, becomes the property of the entire community and restructures the scientific background against which research teams large and small plan and execute new ventures. Moreover, "Big Science" is a general term whose meaning varies from one branch of science to another. It can refer to the construction of large instruments used by only a small fraction of the community at once, as in astronomy; large equipment complexes serving many individuals simultaneously, as in materials science; or the coordination of the work of numerous small research teams, as in biology. In each case the funding needs, the size and role of research groups, and the information flow between project users and the wider scientific community is different. It is thus meaningless to debate the value of Big Science in general; projects must be judged on an individual basis.

Nevertheless, the *management* problems of such large-scale projects are similar, and therefore the experience of high-energy physics, in which such problems were first felt, is likely to be emblematic. Big Science meant that high-energy physics outgrew the environment single universities could provide. The national laboratories had a special mission: to provide favorable environments in which such science could continue to grow. But the new scientific theaters had vastly different requirements from those of just a decade or so earlier. It was not simply a matter of bigger equipment, along with the need for more-extensive construction and planning. The new laboratories also required things like offices for procurement, maintenance, health and safety, security, architectural planning, and budget. They needed departments for photography, technical information, public information, and legal counsel. The commitment to maintaining such a large organization inevitably posed a threat to the freedom and flexibility of the basic research that was supposed to be carried out. Science management had become a problem—one that grew with the size of the laboratories.

The solution adopted was the administrative contract. Administrative contracts date from the era of the Atomic Energy Act of 1946, and the historic compromise it effected between the U.S. government and the U.S. physics community. The government was trying to balance its desire for a first-class scientific program with its desire for secrecy and control of the direction of nuclear-reactor technology. The physics community wanted the nuclear reactors and particle accelerators that were soon to become fundamental tools of Big Science, but also wanted to work independent of the government, which was the only conceivable source of funds. Administrative contracts permitted the government to participate in science while preserving the atmosphere of university laboratories.

Administrative contracts were soon written establishing several national laboratories, some through the reorganization of existing labs: Brookhaven National Laboratory, on Long Island, New York (the contractor was Associated Universities, Inc., a nonprofit group of universities in the region); Berkeley Radiation Laboratory, in Berkeley, California (University of California), now called Lawrence Berkeley Laboratory; Argonne National Laboratory, outside Chicago (University of Chicago); and Oak Ridge National Laboratory (built largely by Du Pont and now run by Martin Marietta). In addition to these basic-research facilities, a string of laboratories oriented toward military projects were also set up under administrative contract. Besides Los Alamos (University of California), these included Livermore Laboratory, in Livermore, California (also the University of California), now called Lawrence Livermore National Laboratory; and Sandia Laboratories, in Albuquerque, New Mexico (AT&T, through a subsidiary, the Sandia Corporation). When the contractor was a university or similar nonprofit organization, it received a management fee to cover its costs. Commercial companies came to receive an "award fee" along with reimbursement for their costs, in an amount depending on a judgment about the effectiveness of the management in any given year. The commercial companies participated not for the money but partly in order to contribute to the good of the country, partly to provide a training ground for employees, and partly to benefit from the transfer of new technology. The Sandia Corporation, for instance, has managed the Sandia Laboratories for forty years without any award fee.

The arrangement worked so well that when a group of European nations founded CERN, a laboratory in Geneva, in 1953, its management was patterned after the administrative contracts of the Atomic Energy Commission (AEC). "It is the desire of the Commission," a typical contract stated at the outset, "to procure for the Government managerial skill and responsibility which will permit flexibility in administrative controls and freedom from detailed supervision." Many of these contracts carried what became known as the sweetness-and-light clause: "It is the intent of the Commission and the Contractor that this agreement shall be carried on in a spirit of partnership and friendly cooperation with a maximum of effort and common sense in achieving their common objectives."

The special character of administrative contracts can best be seen by comparing them with the two most common types of government contracts, fixed-price and cost-plus-fixed-fee. Suppose, for instance, that the government wants to buy Army hats. It draws up specifications, determines which sizes and colors it wants, and then solicits bids. If the winner of the contract, a fixed-price one, cannot produce the specified hats on budget, it must bear the additional cost itself or renegotiate the contract. Cost-plus-fixed-fee contracts cover situations where the scope of the work precludes a basis for determining a fixed price. Suppose the government wants a series of metals to be evaluated for use in space vehicles. It might produce a detailed description of the tests it wants done, prescribing how long the process is to take, how often it will want to receive reports, and so on, and invite interested parties to negotiate a contract in which the government agrees to pay whatever costs are incurred plus a fixed fee. In both kinds of contracts the aim is to pin the contractor down to as many specifics as possible. Both presuppose a conventional buyer-seller relationship.

Administrative contracts envision an entirely different relationship between contractee and contractor, one that is essentially collaborative. It is taken for granted, for instance, that the relationship will be long-term; contractors are formally reviewed after five years but do not necessarily have to undergo a competitive rebidding process. Although the AEC determined its laboratories' basic direction, approved long-range plans, and played an important role in health and safety policies, other management issues were the responsibility of the contractor, who was allowed maximum flexibility in deciding them.

The Intrusion of Bureaucracy and Politics

ADMINISTRATIVE CONTRACTS WERE CREATED IN the knowledge that special management methods are required by the special environment in which basic research thrives. Yet the fruits of basic research—and their obvious ability to transform society—have made it tempting for the government to think that basic research can and should be managed for social ends, and that therefore conventional management models and methods can and should be applied to it. Little by little the government has succumbed to this temptation, and has come to adopt the perspective that basic-research facilities can be operated just like other corporate entities. The result has been to erode two fundamental kinds of independence originally granted to contractors: the relative independence from bureaucratic restrictions applied to other federal agencies, and the relative independence from political pressures.

The federal government long ago established a system of regulations to cover the contracting and purchasing functions of its agencies and any subcontracting carried out by those agencies. The reasons for doing so include the government's interest in preventing collusion, fraud, incompetence, and inefficiency, and its interest in promoting certain social ends.

The first administrative contracts, however, exempted the laboratories from such provisions. The promotion rules, salary structures, and personnel regulations of civil service were considered inappropriate to the laboratory environment. Because scientists on the research frontier need to be able to respond quickly to new developments, the elaborate accounting and procurement practices required of government agencies were also thought inappropriate. For such reasons, the contractors who managed the labs were bound by few of the restrictions that were standard in other government contracts, except for basic health and safety provisions. That is not to say that the contractors were given carte blanche; they were accountable for their work through periodic reviews whose conclusions were made available in publicly released reports. But the contractors were freed of the ordinary bureaucratic burdens placed on federal agencies.

That freedom did not last long. Within a few years of the signing of the first administrative contracts many of the boiler-plate provisions of standard government contracts were being written into administrative contracts. These were not unreasonable, and contractors did not find them burdensome. But severer restrictions were applied, through a process known in the jargon as "flow-down," by which restrictive requirements and regulations in one contract tend to flow into others. The first flow-downs came through the AEC, which wrote procurement regulations into its standard contracts. It was often unclear both to the laboratories and to their Washington contract supervisors which of the AEC regulations had to be followed by the laboratories in subcontracting. The problem was exacerbated by the fact that the ultimate court of appeal for contract disputes with the government is the General Accounting Office, which had the right to examine all AEC contracts and subcontracts to evaluate their legality.

Over time the GAO's authority grew, as did the number of its regulations and the penalties for breaking its rules. Inevitably contractors began to play it safe and adopt the conventional contracting practices even when not technically necessary.

AEC procurement regulations were but one source of flow-down. Around 1960 a second source appeared with the creation of a set of federal procurement regulations. Once again, it was frequently unclear both to the laboratory managers and to contract administrators which regulations were to be applied to the administrative contracts; once again, the fact that the GAO had the final say discouraged the laboratories from making aggressive and flexible contracting decisions.

In 1975 the AEC ceased to be, and most of its functions were taken over by the short-lived Energy Research and Development Administration, which in turn was superseded by the Department of Energy, in 1977. The flow-down now became a torrent, thanks to a change in the character of the agency overseeing the laboratories. The AEC staff had always included a number of scientists who engaged in basic research, and the agency's five commissioners had always included at least one basic scientist. The professional staff of the AEC, like those of the Tennessee Valley Authority, the FBI, and a few other agencies, was exempt from civil-service requirements, meaning that it had a great deal of flexibility in selecting and assigning laboratory personnel. The Department of Energy, however, has never had a basic scientist at its helm, and is staffed largely by officials with little or no familiarity with basic research and its particular requirements. People arrived at the new agency with no awareness of the reason why administrative contracts had been established in the first place and no experience in handling them, and expected that the contractors who ran the national labs would follow the same regulations as everyone else.

In 1982 an advisory panel reported to the DOE that "the laboratories have become grossly overburdened with detailed reporting and other paperwork requirements, the utility of which frequently is not apparent and which unnecessarily divert resources from their research and development missions"; nothing, however, was done in response to the complaint. Similar conclusions were reached in subsequent years, with similar outcomes, by a presidential commission and a second advisory panel.

The result is that the national laboratories have to divert an increasing portion of their resources in order to satisfy federal bureaucratic provisions from which they were meant to be exempt. It is a question not of science administration having to grow in scale with the size of scientific projects but of the breakdown of the independence that the administrative-contract system was designed to safeguard. Three decades ago the procurement regulations that bound laboratories were available in a small booklet. Today each lab has several feet of "DOE orders," with additional ones arriving weekly. In the past ten years alone the budget departments at the national laboratories have doubled—not because they need additional help in preparing the budgets but because of the DOE's never-ending requests for information. Whereas agreements between contractors and the government aimed at a relationship of "sweetness and light" forty years ago, today the relationship is described as "at arm's length." Some examples:

- The DOE requires laboratory directors to approve each request for international-travel funds, and if the requests are filed within thirty days of the start of the proposed trip, they must be approved by the appropriate DOE offices in Washington. This regulation is absurd. Given the international character of contemporary science, international conferences are necessarily one of its important tools. Brookhaven scientists, for instance, make about 300 foreign-travel applications a year. DOE regulations require so much reporting and follow-up that the Brookhaven administration includes two people who work full-time to process applications.
- Following a recommendation of the 1982 advisory panel, the DOE established a program to provide lab directors with seed money for promoting new initiatives. The program has led to a number of important new research efforts that otherwise would have been delayed or abandoned. Last year, however, some scientists at Lawrence Livermore National Laboratory attempted to use the program to develop an idea to visit Mars using inflatable spacecraft. The plan completely bypassed input from NASA. Angered, Congress retaliated by eliminating the new-initiatives program. Ultimately it was restored, but with additional procedures and restrictions. Whatever one's opinion of space exploration, the story illustrates a bureaucratic tendency to punish all labs for an action at one.
- Last year Brookhaven couldn't get its integrated circuits made. Custom semiconductor chips are a component of experimental devices and instrumentation of all sorts. For a laboratory to have no new chips is something akin to a hospital's running out of penicillin. Integrated circuits are prohibitively expensive for a laboratory unless bought jointly with other institutions. When Brookhaven joined a consortium of others to acquire chips, however, some officials read the DOE requirements as prohibiting such a cooperative venture because of certain restrictions on submitting a purchase order to private industry. The laboratory spent a year tinkering with the agreement to make it valid, only then determining that the officials were merely playing it safe with the DOE requirements. Before the matter was straightened out, several major projects ground to a halt.

AT A TIME OF WIDESPREAD LAMENTATIONS ABOUT THE LOSS OF U.S. TECHNOLOGICAL COMPETITIVENESS, IT IS IRONIC THAT WE ARE DESTROYING ONE OF THE MOST IMPORTANT MEANS BY WHICH WE ESTABLISHED THAT TECHNOLOGICAL COMPETITIVENESS IN THE FIRST PLACE.

Revitalizing Scientific Culture

IT WAS ONE INTENTION OF THE ATOMIC ENERGY ACT to keep political hands off the basic-research budget as much as possible. One part of the act, for instance, provided for the evaluation and selection of research proposals by independent panels of scientists. Another sought to insulate the selected proposals and expedite the budgetary approval needed from Congress by the creation of a single congressional committee to oversee the basic-research budget, the Joint Committee on Atomic Energy—the only permanent joint committee with continuing legislative responsibility ever created. Many in and out of Congress were jealous of the joint committee's tremendous power. But throughout its tenure the joint committee respected the independence of the laboratories in conveying to the scientific community merely general areas of government concern, and insisting on the peer review of programs meant to address these concerns.

The demise of the AEC meant the eventual dissolution of the joint committee, which left the basic-research budget to be parceled out by a complex network of committees with overlapping jurisdictions. The absence of a single committee with a continuing vision exposed the basic-research budget to the political whims of successive presidential administrations. Laboratory programs established by one administration have been axed by the next.

Moreover, the parceling out of the basic-research budget also meant a growing vulnerability to pork-barreling, which can be defined as any non-peer-reviewed and -approved project. During the lifespan of the joint committee a few minor pork projects had made it into the budget, but the committee had aggressively kept the lid on. The lid opened, however, during the Reagan Administration. In 1982 George Keyworth, the presidential science adviser, apparently at the request of certain California constituents, attempted to bypass the peer-review process and insert funds for a National Center for Advanced Materials (NCAM, but soon referred to as NSCAM) directly into the DOE budget as a "presidential initiative." A $140 million project, it would have been the largest undertaking ever in materials science. A storm of protest led Congress to defer the project temporarily, but much of it has been reinstated.

After that episode Congress lost the restraint with which it had traditionally approached the basic-research budget. If presidential initiatives were possible, it was argued, so were congressional initiatives, and universities began to lobby Congress directly for them. In 1983 Cassidy & Associates, a lobbying firm, succeeded in getting Congress to earmark $5 million of the DOE budget for a chemistry building for one of its clients, Columbia University. The same year the firm snagged another $5 million for a vitreous-state research laboratory at Catholic University, in Washington, D.C. Cassidy has become the lobbyist of choice for universities. It is estimated that in the four-year period from 1982 to 1986 the funds earmarked for pork projects bypassing the peer-review process soared from $2 million to $236 million.

Behind the proliferation of bureaucracy and politics is a deep misunderstanding of the scientific process, in which basic research is viewed as essentially a corporate undertaking and hence something that can be manipulated for profit or social ends. Basic research flourishes—and society reaps the greatest benefits—when it is viewed not as a profit-making venture or as an instrument of social change but as an exploration of nature. To provide basic research with the special conditions appropriate to its execution amounts not to granting it a special status but simply to recognizing what it is and what are the conditions under which it should be done.

The hidden cost of imposing on basic research the same procurement procedures, budgetary constraints, and general regulations imposed on other areas of the federal bureaucracy is the sharp reduction of that flexibility which keeps basic research vital. We appear to be losing our technological leadership, and if we are not careful, we may lose our scientific leadership as well. It is true that the United States still holds the lion's share of science Nobel Prizes awarded since the Second World War. But we may be riding on past accomplishments. The 1990 Nobel in physics was won by three Americans for work done two decades ago, the 1989 prize by an American for work done in the 1940s, the 1988 prize by three Americans for work done a quarter century ago. In the past decade most of the physics Nobels awarded for recent efforts have gone to Europeans.

Recently the Department of Energy has taken some promising steps. In the current year's budget, for instance, it has recognized basic research in science as a category in its own right, which it calls "Fortifying Foundations"; in previous years the budget for basic research in science was classified under "Energy Research & Development." But much more needs to be done. We propose the following steps:

- Return to the original administrative-contract idea of flexibility and independence. For instance, the number of congressional committees through which the basic-research budget has to pass should be limited, and many accounting and procurement requirements eliminated. One cannot run science as a procurement activity.
- Establish a long-term science policy for basic research, identifying areas of interest and opportunity, and couple this with a two-year funding plan. The long-term policy would prevent the basic-research budget from fluctuating and make programs more effective by buffering them against the whims of Congress and of new administrations. A mechanism for establishing such a policy already exists, in the form of national science advisory and DOE committees; their mandate should be extended. Two years of funding cannot be guaranteed, since Congress makes only one-year appropriations; nevertheless, planning funding according to that time frame would be an improvement over the present system. Since congressional project additions are a way of life, they will continue. However, they should be budgetary add-ons and not come at the expense of ongoing programs.
- Reduce the number of DOE orders to laboratories, and end the bureaucratic mentality that formulates a new rule following every offense. Much more effective would be to treat the individual case first. Each DOE institution—and, indeed, each of the national laboratories—is unique. Each has different facilities, skills, styles, personnel, problems, and goals. A solution to a problem at one lab may not work and may even be harmful at another.

Genuine scientific culture, like all human culture, is achieved through organic growth rather than the execution of a plan. One cannot suddenly decide to buy a forefront scientific program and then go out and exploit it. Do we demand of basic research that it be of potential social or military use? Do we insist that it pay for itself? Or do we try to foster in those who do science the ability to follow their intuitions about how the world works? On the answers we give to such questions depends the future of science in the United States. □

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Science, Technology and the Western Miracle

Close links between the growth of scientific knowledge and the rise of technology have permitted the market economies of the Western nations to achieve unprecedented prosperity

by Nathan Rosenberg and L. E. Birdzell, Jr.

Economic inequality between nations is to a considerable degree an invention of the past two and a half centuries. In the mid-1700s the average inhabitant of western Europe had a material welfare not too different from that of someone in China or, for that matter, in ancient Greece or Rome. Only a minority of the population enjoyed an income appreciably in excess of the minimum required to sustain life, and the elites of one nation had little reason to envy those of another.

By about 1800, however, it became apparent that the minority in Europe with incomes above the subsistence level was growing, at least in part because European science and technology were progressing faster than science and technology elsewhere. The increase in the number of factories and in the use of mechanically powered machinery came to be called the Industrial Revolution. The process of growth and change accelerated during the 19th century and has continued through the 20th. Historians sometimes call this unique period of long-term economic growth, which has made the West conspicuously richer and more powerful than the rest of the world, "the Western miracle."

To describe this phenomenon simply as long-term economic growth fails to convey its true dimensions. Between the mid-1700s and the present, per capita income increased tenfold. The population of Europe grew fivefold and that of the U.S. 80-fold. Infant mortality declined drastically, and the average life span doubled. Famine was banished, and plagues disappeared. Food production, which in some countries had occupied as much as 90 percent of the working population, eventually came to occupy less than 5 percent. Nineteenth-century urbanization marched in step with developing technologies for improved sanitation, construction, communication, power distribution and other services. Urbanization and rising incomes led to changes in health and living standards, work patterns, values and other aspects of personal, family and community life.

One might suppose that economic historians would have long since settled on the reasons for the Western miracle, but the phenomenon has not received the scrutiny it deserves. Consequently, when the less developed countries of the Third World turned to the West 40 years ago for help in raising their per capita incomes, much of the advice they received reflected an inadequate understanding of how the West had achieved its affluence. Very recently, the apparent determination of the Soviet Union and the Eastern European countries to close the large gaps between their income levels and those of the West has given fresh urgency to the question: What are the sources of Western growth that have eluded the less developed and socialist countries?

A variety of popular explanations for the Western miracle have been proposed. Some attribute it to imperialism, even though many of the most economically successful countries grew prosperous before resorting to imperialism and such highly affluent countries as Norway and Switzerland never adopted imperialist policies at all. Conversely, several of the most formidable imperialist powers, such as Spain and Portugal, rapidly deteriorated into economic stagnation.

Other theories link wealth to the possession of natural resources. Those resources do not become economic assets, however, until the knowledge and means of using them become available. The pre-Columbian peoples of North America had about the same resources as the present inhabitants do. Japan, which has far fewer natural resources than Indonesia, Mexico or the Soviet Union, has been far more successful in achieving growth. The modern histories of the city-states of Hong Kong and Singapore—not to mention that of Ven-

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ice, which had only a swamp for its natural resources—belie the natural resources explanation.

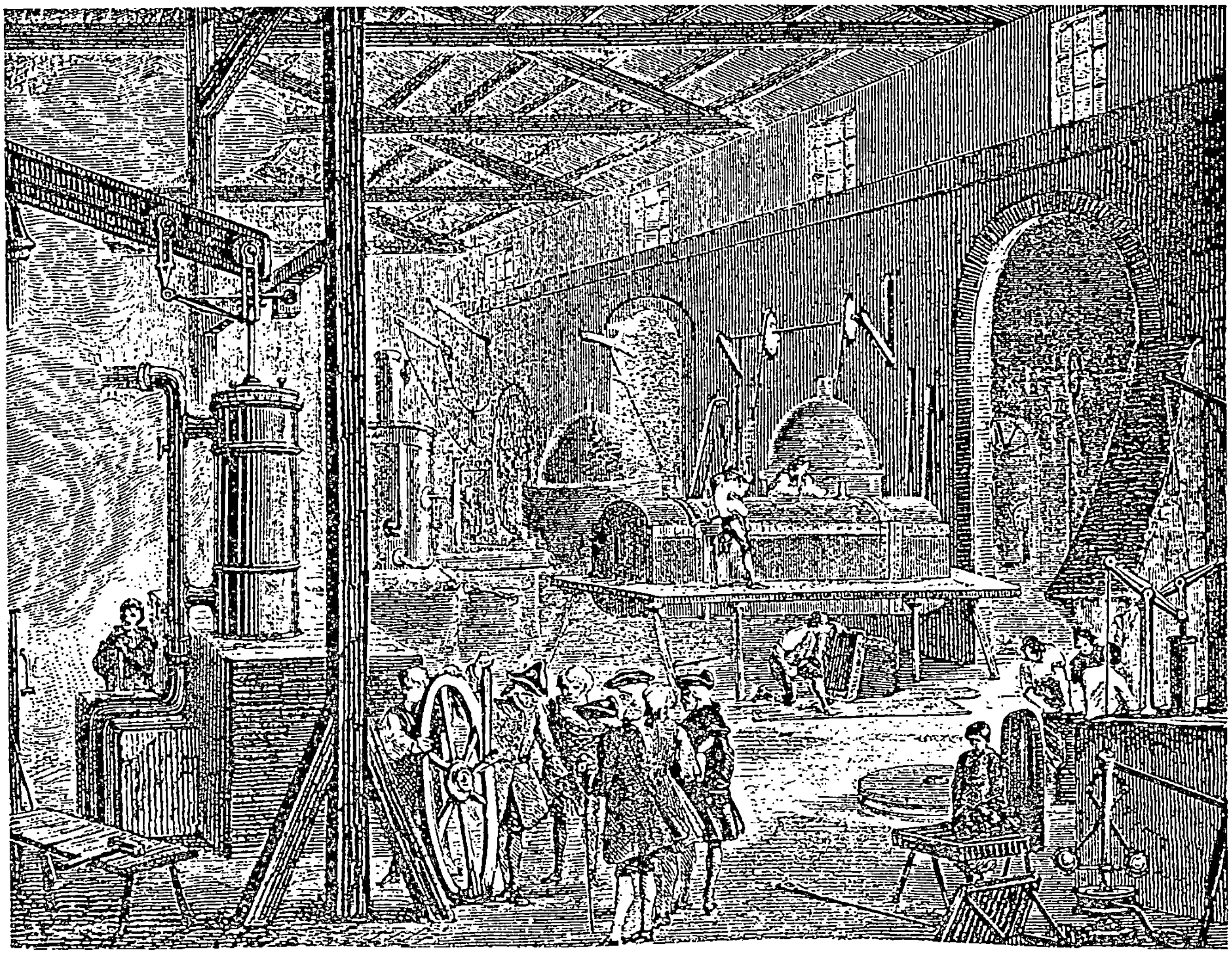
These hypotheses have had an unfortunate effect on government policies in the developing countries. By focusing on factors of questionable relevance, they have distracted attention from institutional changes that might have provided avenues to growth, especially ones that might have given access to superior technologies.

Western technology developed primarily within the economic sphere, and it has often been regarded as merely an outgrowth of economic needs and institutions. Science, in contrast, had more complicated origins and could hardly be dismissed as an automatic response to economic conditions. For a long time, science contributed little to economic growth and industrial technology. When Karl Marx was writing in the mid-19th century, the "colossal productive forces" he saw at work had been created primarily by people working in industry, with little contribution from people whom we would call scientists today. The mechanical skill and ingenuity that produced the precision machinery and instruments of 18th- and 19th-century factories and laboratories came more from the crafts of clock making and lens grinding than from science.

Since about 1880, however, industrial technology has come to owe a more substantial debt to scientific sources outside industry. With the success of efforts to fit natural phenomena to theoretical structures inaccessible without special training, industrial engineers with that training have become transmitters and users of scientific knowledge and methods. More than that, during the past century industry has created research laboratories capable of extending the theoretical structures of science. Although Western science originated as an institution outside the economic sphere, during the 20th century its advance has become inseparable from that of industrial technology and Western economies.

To explain the Western economic miracle and its relation to science, we must first consider some of the reasons for the great success of Western science—an achievement with its own claims to the title "miracle." One reason is that Western science has made a better organized attack on the secrets of nature and used greater resources in the assault than science in other cultures.

For a long time after the printing press was introduced in the late 15th century, scientific research remained chiefly a decentralized—or even individualized—activity, in which isolated scientists occasionally communicated their discoveries to one another in print or in longhand. Early Western science was clearly not a localized phe-



SOHO MANUFACTORY near Birmingham, England, produced parts for steam engines in the 18th century. The partners in the enterprise, James Watt (the father of efficient steam engines) and Matthew Boulton, were members of the Lunar Society of Birmingham, a group of businessmen, inventors and scientists. Throughout the Western world, similar associations between scientists and entrepreneurs fostered scientific, technological and economic progress simultaneously.

nomenon: its venues ranged from the Poland of Copernicus to the Denmark of Tycho Brahe to the northern Italy of Galileo to the Bohemia of Kepler to the France of Descartes and Lavoisier to the England of Boyle and Newton.

The early achievements of Western science centered on astronomy. The development of a significant scientific community in Europe with interests beyond astronomy dates from the 17th century. In 1660 the Royal Society of London for Improving Natural Knowledge (almost always called simply the Royal Society) was formed to discuss reports from the many individuals who were by then conducting scientific investigations. Many other such societies formed in the 17th and 18th centuries, setting up a network of scientists in Europe who exchanged information not only with one another but also with a distant American named Benjamin Franklin, whose experiments had shown that lightning was electricity.

These societies, and the journals they published, both disseminated new research and screened it for admission to the scientific canon. Their discussions set an agenda for the time and served as a pointer to new research that might bring recognition and acclaim from other scientists. What they did not offer was a means of earning a living. In 1695, for example, Isaac Newton faced limited academic advancement at Cambridge because he had not taken holy orders. To reward him for his scientific contributions with a livelihood, the British government had to name Newton to a post outside the scientific community, as warden of the Mint.

Although the idea of bringing scientists together for directed research in an institute equipped with laboratory instruments and a suitable library was tried successfully in the first half of the 15th century by Prince Henry the Navigator of Portugal, it came into common practice only in the early 19th century. In London Sir Joseph Banks, Count Rumford and some other fellows of the Royal Society formed the Royal Institution in 1799 to serve as a laboratory where scientists could work together and teach. Michael Faraday, working a century after Newton, found a full career at the Royal Institution, where he discovered electromagnetic induction.

Similar institutions sprang up elsewhere. In 1795 the French established the École Polytechnique. In the U.S., Yale University established the Sheffield scientific school in 1847, and the Massachusetts Institute of Technology opened in 1865. Science thus gradually developed its own research and teaching institutions, and successful researchers could be rewarded with staff appointments and promotions.

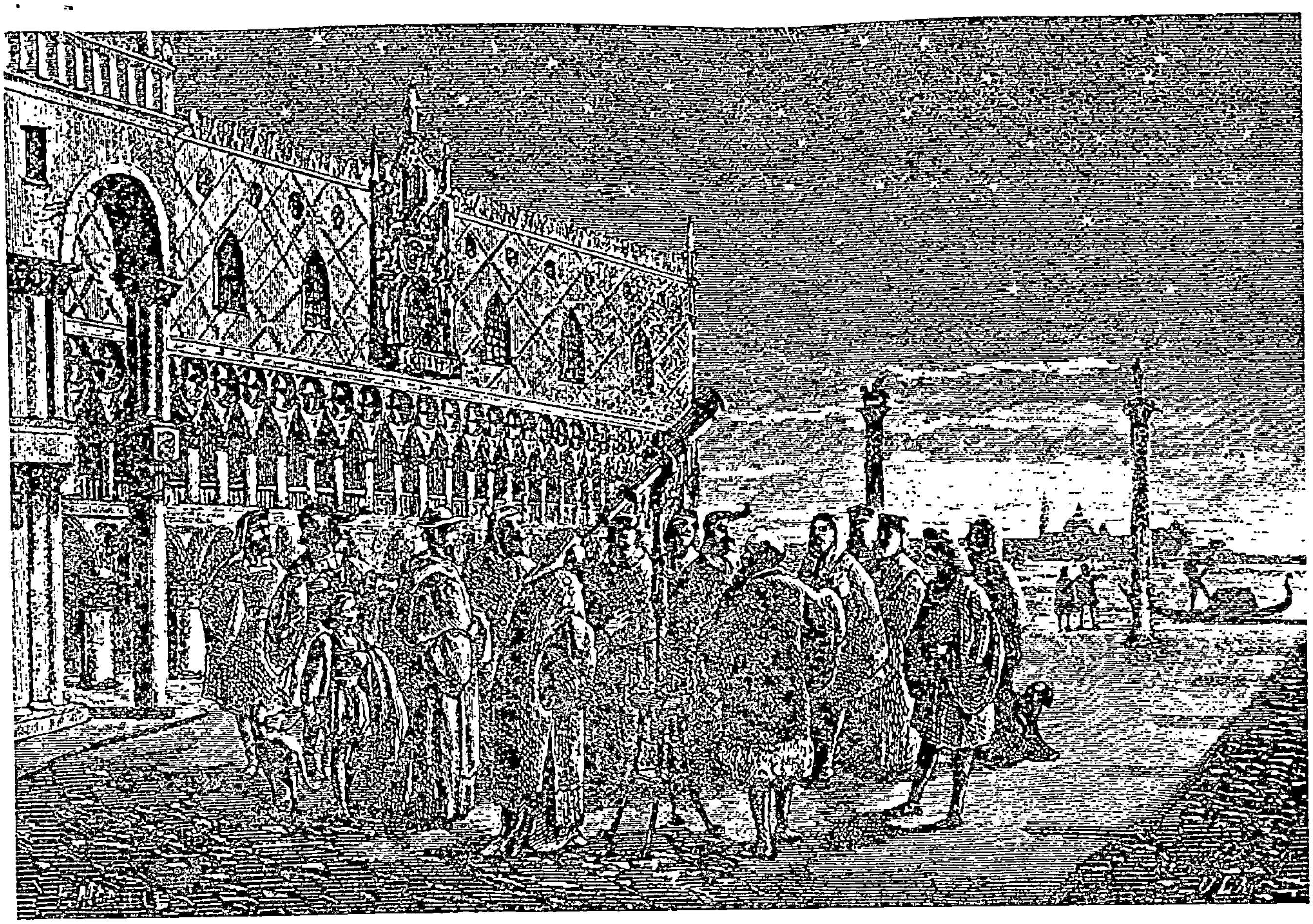
By the early 19th century, Western science had divided into specialized departments: mathematics, astronomy, physics, chemistry, geology, botany, zoology and the medical studies of anatomy and physiology. Some of them, such as physics, were divided into still finer specialties.

Western science had become an institution with a broad general goal (to explain natural phenomena), a division of labor into specialized departments with their own subsidiary goals, an information network that kept its members informed of progress, a peer review system for evaluating new work and settling conflicts, formal centers for teaching and research, and a set of rewards for work rated favorably by the profession.

A fundamental factor holding the enterprise together was its adoption of a single standard of scientific truth based on observation, reason, experiment and replicability. The standard enabled scientists to make use of findings from other laboratories, even from those in other disciplines. It also permitted artisans, merchants, manufacturers and the rest of the working population to apply scientific discoveries to everyday labors.

Its organization and scope are, of course, not the only reasons Western science flourished. It also fell heir to the vast intellectual estate of earlier civilizations: a phonetic alphabet, an Arabic (or possibly Indian) counting system that included zero as a number, mathematics that included geometry and algebra, and religions that freed nature of animism. But the West was no idle heir, for by the beginning of the 18th century it had added some intellectual monuments of its own.

ILLUSTRIOUS SCIENTISTS throughout Europe contributed to the growth of basic knowledge that spurred technological and economic progress. Among them were (*clockwise from upper left*) Nicolaus Copernicus of Poland, Johannes Kepler of Bohemia, Galileo Galilei of northern Italy and Sir Isaac Newton of Great Britain.



VENETIAN SENATORS peer at the moons of Jupiter through a telescope under the direction of Galileo. Astronomy was one of the first interests of Western science, but before the end of the 17th century, Europe began to have a sizable scientific community interested in physics, medical science and other fields. Science slowly became a less individualized endeavor.

Calculus, for example, was clearly a landmark contribution. Another, and perhaps the most fundamental, Western contribution was the development of the scientific method, which from the time of Galileo included a refined form of systematic experimentation. Hellenistic, Islamic and Chinese scientists and inventors understood the use of experiments for testing and confirming ideas, but they do not seem to have achieved anything like Galileo's inclined plane experiments, in which conditions were systematically varied as a way of exploring how nature works. Nor did they anticipate Newton's thought experiments, in which idealized phenomena (for example, motion in a vacuum) are used to explain real phenomena.

Without systematic experimentation, progress can be slow and fitful in science and in technology. Improvements in the design of the plow, for example, were inventions of great significance in predominantly agricultural societies, but they took place hundreds of years apart. Before the age of science, no one seems to have tried to improve plow designs by comparing the effectiveness of different blade designs in various soils. Concrete was known to the ancient Romans, but it was little used as a building material until late in the 19th century, when chemists experimentally investigated its suitability for structural applications by systematically varying the mix of its ingredients. Within a few decades, concrete, including reinforced concrete, became the most widely used (by weight) of Western building materials.

Perhaps the most important point about Western science and technology is that they were linked at all. In other civilizations, economically useful technologies depended minimally, if at all, on the wisdom of astronomers (or astrologers), philosophers, mathematicians and other sages. These thinkers had little to offer to farmers, sailors, smiths and other artisans who had developed their technologies within their craft traditions. In fact, the thinkers often confined themselves to an abstract world of ideas as an escape from the transient and imperfect, real world. For Western scientists, however, there was no escape. Their empirical methods required them to engage the real world. It is precisely because the scientists were so engaged that they accomplished so much.

Third World and Eastern European countries trail the West economically, despite having access to the world's stock of scientific knowledge. Indeed, the Soviet Union has made substantial contributions to that stock. What those countries seem to lack is the West's capacity to translate scientific knowledge into economic productivity—a capacity that depends on the individual and institutional characteristics of a nation. In many ways, technology, which is intermediate between scientific knowledge and economic activity, grows out of local needs and institutions, and its economically successful transfer involves more than a teaching process.

One clear requirement for economic growth is the ability to shape productive technology to local needs. Whatever the origins of a technology, the people and institutions using it must be able to understand it, experiment with it and evaluate the economic repercussions of its use.

Japan, usually regarded as the first

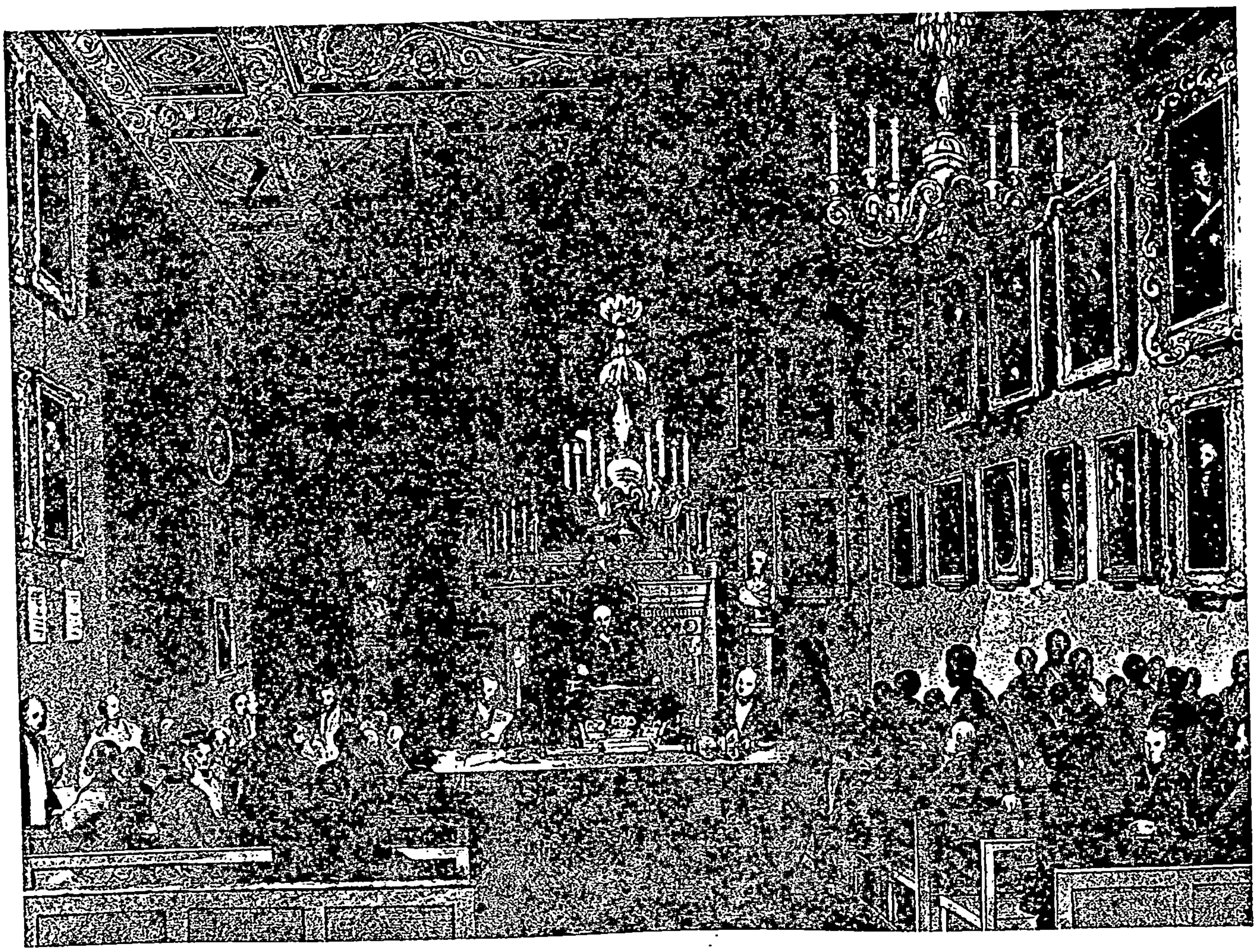
non-Western country to match the economic achievement of the West, offers an instructive example of institutions appropriately applying technologies. The first stages of Japanese modernization, beginning in the late 1860s, emphasized agricultural improvements. The technologies initially borrowed from North America were capital intensive and tended to maximize output per worker. The Japanese soon realized, however, that techniques suitable for the land-abundant U.S. were inappropriate in an economy that had ample labor but was seriously short of arable land. They then shifted to other technologies, borrowed this time primarily from western Europe, that were more labor intensive and that maximized the productivity of the scarcest Japanese resource—land.

In manufacturing, too, Japan adapted Western technology to its labor-rich, capital-poor economy. Japanese factories often purchased secondhand rather than new machinery. Wherever possible, they substituted labor for capital and used foreign technologies in more labor-intensive ways. Textile mills, for example, added extra work shifts and expended more labor on maintaining and repairing machinery to prolong its life. When the Japanese constructed a railway system, they used more than two and a half times as many workers per mile of track as the Americans did.

Parallels between the development of industry in Japan and in the U.S., where it began several decades earlier, are often overlooked. Like Japan, the U.S. at first borrowed technology, primarily from England. Industrialization began in New England, New York, Pennsylvania and Delaware—regions where, as in Japan, literacy and formal education were already valued. The U.S. also had to adapt its borrowed technologies to the country's special circumstances, as Japan did.

Because the U.S. had abundant natural resources, however, its adaptations involved making the industrial technologies more resource intensive and less labor intensive. Europeans visiting the U.S. in the mid-19th century often criticized Americans for wasting natural resources. U.S. agricultural techniques did frequently lead to rapid declines in soil fertility, but more land was always available, so the losses were supportable: Americans invented woodworking machinery that appeared extremely wasteful to the British. At the time, however, it made good economic sense in a country so richly endowed with forests.

Late in the 19th century, private business firms in Germany and the U.S. founded industrial research laboratories for developing new products and production methods. In 1856 the English chemist William Henry Perkin discovered aniline purple, the first of the industrially useful coal-tar derivative dyes, and the next year he established a factory for its production. This work marked the beginning of both a major branch of chemistry and a major chemical industry. Perkin went on to make further contributions, but no one individual could ring all the changes on the chemistry of coal-tar derivatives. That accomplishment required institutional



ROYAL SOCIETY OF LONDON for Improving Natural Knowledge, founded in 1660, was one of the earliest associations for advancing the communication of scientific information. Such societies evaluated discoveries and disseminated them.

invention. Only after German chemical manufacturers established several research laboratories for systematic, organized investigations did an important industry arise around the coal-tar dyes between 1890 and 1914.

The accomplishments of the German laboratories inspired the establishment of the General Electric Company's research laboratory in the U.S. When GE was formed in 1892, it relied at first on Charles Steinmetz, a talented political refugee from Germany, as its resident inventor. In 1900, however, after the new German laboratories produced superior materials for electric-lamp filaments, GE engaged Willis R. Whitney, a professor of chemistry at the Massachusetts Institute of Technology, to organize a formal laboratory. During the first half of the 20th century, the number of research laboratories affiliated with private firms multiplied, creating major new institutions that significantly contributed to the growth of basic scientific knowledge as well as to technology.

The best road to technological progress is often poorly marked. The great virtue of private businesses in market economies is that they become independent sources of decision making for exploring the frontiers of technology. No single individual or institution has the authority to veto an exploratory undertaking unilaterally. The importance of diffusing decision making is illustrated by the success of the personal computer, which is said to have been turned down by the principal U.S. computer manufacturer. Similarly, the export of Japanese automobiles to the U.S. was initiated by a Japanese company against the advice of the Japanese government. To be sure, the government was right, because the first cars exported were designed for Japanese use and performed poorly in the hands of early U.S. customers. The exporter nonetheless learned what was required for the U.S. market and took the necessary corrective action. It was soon followed profitably by other companies.

Given the scientific, technological and commercial uncertainties of innovation, an efficient economy has to strike a balance between undertaking only the safest of projects and pursuing every idea that comes along, too often persisting long after realistic hope of success has vanished. With their rewards and penalties, market economies have so far been most successful in striking the required balance and transforming scientific and technological knowledge into useful goods and services.

Nevertheless, the economies' open-ended diffusion of authority to start innovative projects would be unworkable if decision makers' hopes of high rewards were not tempered by their exposure to the risk of severe losses. Public attention commonly goes to the occasionally sensational rewards of innovation, but the prudent investor keeps in mind the institutional role of the bankruptcy courts in Western innovation: burying the failures.

In the West, although innovative contributions often originate with long-established firms, many of the most important inventions have been commercialized by new firms formed for that purpose or by completely redeployed old firms. The role of new firms in innovation is important not only for its direct contribution but for its implicit threat to older firms, which might not otherwise feel impelled to take the risks of innovation. Yet freedom to organize new firms is narrowly restricted in socialist countries and severely hampered in some less developed countries, where permission from scores of government agencies may be required to launch a business enterprise.

In addition to corporate research and development, Western countries have developed several other sources of economically useful knowledge during the 20th century, especially in areas where markets have not provided adequate incentives. Government funding has become particularly important for research that has grown fearfully expensive, as it has in particle physics. Governments also support research in such fields as public health, preventive medicine, the treatment of rare diseases and safety—fields in which the goals are universally desired but there is little prospect of reward for private firms. Government-sponsored research is conducted in both government and private laboratories. To an increasing extent since World War II, universities also have become centers of tax-supported research activities, technological as well as scientific.

Economic growth in the West has been marked by an increase in trade and in the sizes of markets. Part of the increase in trade was tied to technological improvements in ships and to the introduction of railroads—innovations that lowered the costs and risks of transportation. As trade in regional specialties became possible, manufacturers could reach markets large enough to justify investing in mass-production technologies. The introduction of refrigerated ships, for example, enabled a growing European population to trade its manufactured products for meat from Argentina, Australia and the U.S. More recently the increased size of international markets has made it economical for manufacturers to furnish products in greater variety, more closely adapted to the local needs of particular countries or groups of customers. This trend can be observed in markets as diverse as automobiles, clothing, processed foods and electronics.

In recent years the importance of international trade has been highlighted by the differences between the growth performances of countries that have actively competed in international markets and of countries that have adopted policies of import substitution (protectionism) or closely regulated trade, as in the socialist countries. There is no consensus about why active participation in international trade seems so closely associated with economic growth. Possible explanations include some combination of scale economies, keener competitive incentives, economies of specialization and abstention from counterproductive impositions on the part of governments of successful exporting countries.

In Western manufacturing, a particularly interesting example of specialization has been the rise of manufacturers who make only component parts and subassemblies, particularly for the automobile, electric and electronics industries. Brand name manufacturers often specialize in the design, the marketing and sometimes the assembly of finished products, with the component parts made by subcontractors. Technological advances conceived by American, German or Japanese engineers can therefore create employment through subcontracted manufacturing not only at home but also in Mexico, South Korea, Taiwan, Singapore and elsewhere. Modern subcontracting networks are also international trading networks, with operations that depend critically on transportation, communication and data-processing facilities that were unimaginable in 1800.

Because trading networks in market economies do not have a central source of authority, their power for efficiently organizing activities went unnoticed until long after the Western miracle had begun. In its lack of central authority, the remarkably successful organization of Western economies paralleled that of Western science, which also lacked a supreme authority and yet became an effective enterprise coordinating the work of thousands of specialized scientists and a wide variety of research institutions. Decentralization is especially relevant to economic growth, but Western societies have also had a comparable degree of autonomy from political control in art, literature, music, religion and other important social spheres.

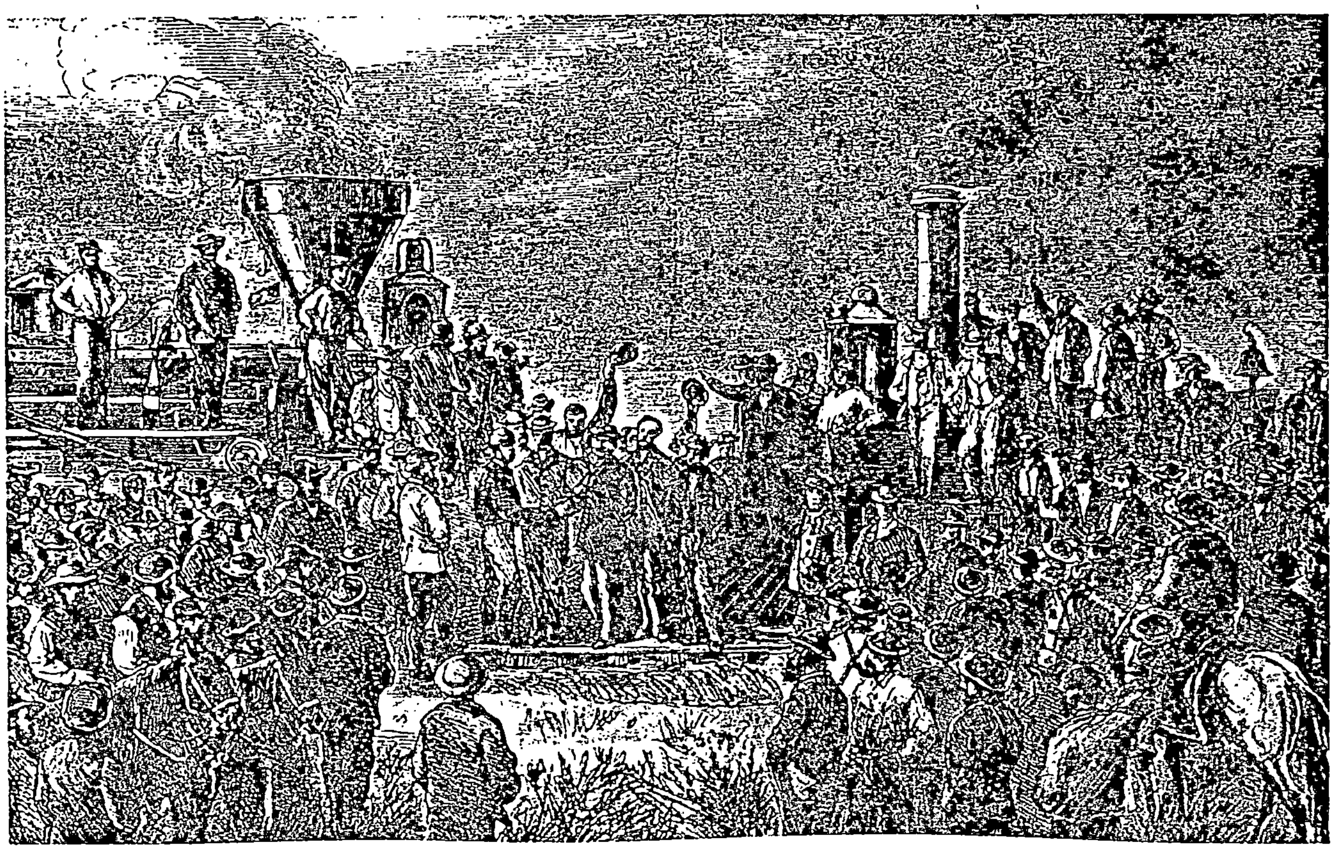
The basic control problem of any economic system is to make and enforce a changing flow of interdependent decisions about production and consumption that will optimize human welfare. Beginning no later than the 12th century, unregulated market trading was gradually insinuated into western European economies traditionally controlled by governments, guilds and the Catholic Church. The centuries-long process was partly one of creating new branches of trade (including international trade) outside the jurisdiction of authorities and partly one of outright evasion. Traditionally, Western authorities had overtly regulated prices and wages to keep them fair according to inevitably subjective criteria.

The slow growth of unregulated market trading gradually reorganized more and more of these economies by transmuting prices and wages into ethically neutral devices for keeping supply and demand synchronized, with consequences for the organization and development of Western economies that did not begin to be widely appreciated until Adam Smith studied them in the latter part of the 18th century. The most visible organizations of those times were governments, armies and the Catholic Church—all hierarchies. For many observers, the very idea of organization implied a hierarchy of authority, and its absence was equated with chaos. People failed to see that through decentralized mechanisms, Western economies were achieving new patterns of specialization and a size and efficiency of organization without historical precedent.

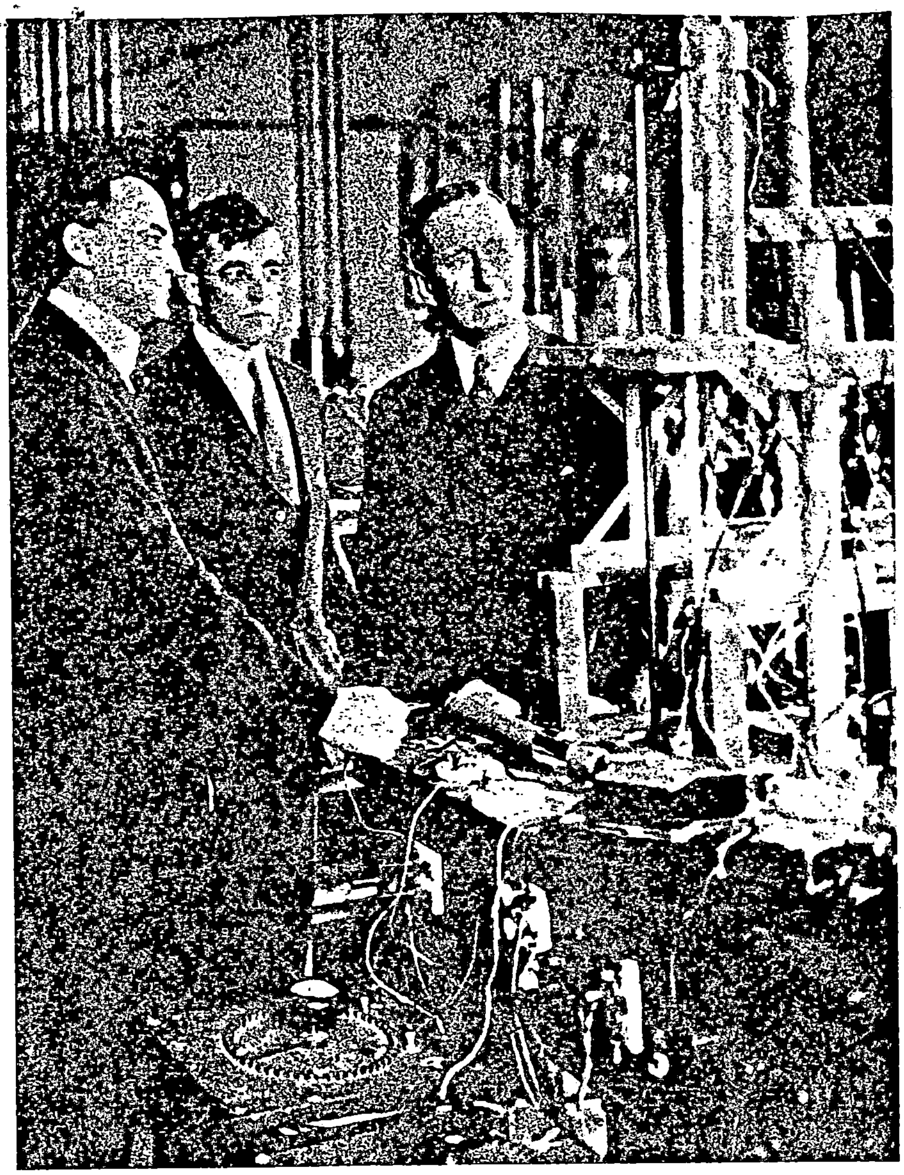
By the time the great German sociologist Max Weber wrote his pioneering work on organization in the early 20th century, the organizing power of markets was widely recognized among social scientists. Yet bureaucracy was looked on by some as an entirely viable alternative that seemed to offer a possible return to the long-lost world of "just" prices and "just" wages that socialists and many others found attractive. The comparative performance of socialist and Western economies over the past seven decades, culminating in the recent upheavals in the Soviet Union and Eastern Europe, suggests that the judgment of equivalence overlooked something important.

Market trading, considered by itself, can be conducted by agents of government, trade unions, consumers, investors or any other groups or individuals. In Western history, however, the introduction of market trading resulted from the efforts of merchants operating within the framework of a peculiarly Western institution, the trading and manufacturing firm. What seems to be peculiarly Western about these institutions is that they have often competed through innovations in products, manufacturing and distribution. The success of Western economies in assimilating Western technology is not a consequence of unregulated markets alone but of markets in which there are productive firms that can gain much by commercializing new ideas more quickly than their rivals can.

As we have already observed, innovation is a risky way to compete, and firms that live or perish by the uncertain irregularities of innovation's rewards and losses are very different institutions from administrative agencies of government. The point is especially significant today for the Soviet Union and Eastern Europe, which, having outlawed the types of entities through which the West conducted commercial innovation, now confront an awesome need for rapid innovation in products, manufacturing and organization if they are to narrow the economic gap



TRANSCONTINENTAL RAILROAD was completed at Promontory Point, Utah, in 1869. Advances in transportation technology fueled economic growth by opening and expanding markets, in turn allowing greater manufacturing specialization.



WILLIS R. WHITNEY, the first director of the General Electric Research Laboratory (*left*), and Irving Langmuir, the Nobel prize-winning industrial chemist (*center*), demonstrate a high-vacuum apparatus to Guglielmo Marconi, the inventor of radio (*right*). Corporate laboratories closely linked technology to scientific knowledge.

between themselves and the Western countries. Although recognition of the need for greater reliance on markets has been increasing, there has so far been less awareness of the critical need to allow Soviet and Eastern European firms to make innovations in products, production methods and organization and to reap the resulting benefits and losses.

In seeking explanations for the Western miracle, we have proposed that long-term economic expansion and technological expansion go together, in that neither has occurred for very long without the other. But although technological and economic expansion are interwoven and inseparable, no simple law of nature makes technology the cause of economic growth or growth the cause of technological advance. An expansion in the size of markets can make a more efficient division of labor and specialization possible without introducing any appreciable technological novelties. The interplay of people, economic institutions, growing markets and technology is the key.

At the end of World War II, many scholars and policymakers believed that the future of all nations lay with socialism—or at least with some other form of planned economy. The older Western market institutions were additionally tainted by associations with colonialism. Consequently, only a handful of developing countries then chose to imitate the Western nations, and even their governments took a more active part in economic affairs than Adam Smith might have prescribed. This handful included Taiwan, South Korea, Hong Kong and Singapore—some of the great economic success stories of this century.

No one can guarantee that other countries would do equally well with a similar policy of imitation. But as we survey 40 years of experience with socialist and populist regimes in Eastern Europe, Asia, Africa and South America, we believe that it requires a victory of faith over experience to see much chance of success without imitation.

Science, no longer solely Western, is pushing back the frontiers of knowledge at what seems an accelerating pace. Because knowledge creates economic resources and because knowledge generally grows at an exponential rate, future advances in human welfare can be at least as striking as those of the past 200 years. Science can also play a much larger role in dealing with such deep-rooted problems as environmental pollution and population growth but only in the context of more effective institutions and personal incentives. Disclosures from Eastern Europe indicate that industrial pollution there has been worse than in the West.

Given the strong prospects for the continued growth of international trade and markets, further Western growth may continue to widen the economic gap between countries that follow the West's example and those that do not. Economic gaps are already creating severe political and social pressures in the developing countries, especially since some of them have demonstrated that the gaps can be closed. Unless these nations take effective action, the consequences could be even less satisfactory than those of the past 40 years.

FURTHER READING

UNBOUND PROMETHEUS: TECHNOLOGICAL CHANGE AND INDUSTRIAL DEVELOPMENT IN WESTERN EUROPE FROM 1750 TO THE PRESENT. David Landes. Cambridge University Press, 1969.

PHASES OF CAPITALIST DEVELOPMENT. Angus Maddison. Oxford University Press, 1982.

INSIDE THE BLACK BOX: TECHNOLOGY AND ECONOMICS. Nathan Rosenberg. Cambridge University Press, 1983.

HOW THE WEST GREW RICH: THE ECONOMIC TRANSFORMATION OF THE INDUSTRIAL WORLD. Nathan Rosenberg and L. E. Birdzell, Jr. Basic Books, 1986.

THE EUROPEAN MIRACLE: ENVIRONMENTS, ECONOMIES, AND GEOPOLITICS IN THE HISTORY OF EUROPE AND ASIA. Second Edition. Edited by E. L. Jones. Cambridge University Press, 1987.

THE WHITE HOUSE

Office of the Press Secretary

For Immediate Release February 2, 1990

SCIENCE AND TECHNOLOGY ACCOMPLISHMENTS AND INITIATIVES OF THE BUSH ADMINISTRATION

FACT SHEET

The President announced today the appointment of the members of the President's Council of Advisors on Science and Technology (PCAST). This distinguished panel of scientists, engineers and industry leaders will provide high-level advice directly to the President on a wide range of important issues concerning science and technology.

Advances in science and technology are a key to increased economic competitiveness and improving our quality of life. The President's action today caps a year of vigorous activity by the Administration to advance science and technology issues on a broad front. The three broad areas of activity are summarized below:

I. Strengthening Federal Science and Technology Policy

II. Enhancing Federal Research and Development Activities

III. Encouraging Increased Private Sector Research and Development Investment

I. Strengthening Federal Science and Technology Policy

- Establishing the National Space Council. -- The President issued an Executive Order on April 20, 1989, establishing the National Space Council, chaired by the Vice President. The Space Council provides advice and assistance to the President on space policy and strategy and monitors and coordinates the implementation of space policy among the civil, national security and commercial space sectors.

- Establishing the Administration's Council on Competitiveness. -- The President established the Council on Competitiveness, chaired by the Vice President, to oversee regulatory and other competitiveness issues, such as reform of product

- more -

- The President has also proposed to allocate $12 billion for basic research, an increase of $1 billion, or 8 percent, over FY 1990. Basic research is an essential investment in the nation's scientific and technological future, including its future scientists and engineers.

B. Science and Technology Education

The President has moved aggressively to address the shortcomings in the nation's science and technology education enterprise. He has set goals for the nation's schools and students in science and math, and the FY 1991 budget will provide over $1 billion in direct spending in five agencies for science, mathematics and engineering education.

- National Science Foundation (NSF). -- NSF will allocate $463 million in FY 1991, a 30 percent increase over FY 1990, for a wide variety of education activities to improve the quality of teachers and students, the numbers of students choosing science, math, or engineering careers, and the numbers staying in those fields, particularly those in traditionally under-represented groups.

- Department of Education. -- The Department will continue to build on its strong relationships with State educational entities. The FY 1991 budget proposes $230 million, an increase of 69 percent, for the Dwight D. Eisenhower Mathematics and Science program, which provides funds to States to implement improved programs for teaching math and science. In addition, five million is requested for the new National Science Scholars program to recognize outstanding high school students by providing fellowship support for them to study in the fields of mathematics and science in college. The Department will also launch an initiative under its Upward Bound program to provide academic assistance and encouragement to help disadvantaged students pursue study in mathematics and science.

- National Aeronautics and Space Administration (NASA). -- NASA will allocate $51 million in FY 1991, an increase of 21 percent, for education activities including the "Spacemobile" program, teacher and student workshops and research experiences at NASA laboratories, and special efforts to increase minority participation in science and engineering.

budget will expand an important environmental, safety, and health initiative in the Antarctic to ensure that this world scientific resource is preserved and that the safety and health of scientists working on the continent are assured.

D. Understanding and Exploring Space

The President is committed to a continuing, active and exciting American presence in space -- indeed, to America's leadership in space science and exploration. Overall, the FY 1991 budget proposes $15.2 billion for NASA, an increase of $2.9 billion, or 24 percent. NASA's budget has increased by almost 40 percent over FY 1989.

- Space Shuttle. -- The current fleet of three Space Shuttles are the world's most versatile launch vehicles. In FY 1989, the Space Shuttle fleet completed four successful flights. The Space Shuttle Columbia recently accomplished the spectacular retrieval of the Long Duration Exposure Facility. The FY 1991 budget proposes $4.2 billion, an increase of 22 percent, for Space Shuttle production and operations. This funding will allow for a safe build-up to 10 Shuttle flights, the delivery of the fourth Shuttle, Endeavor, and enhancements such as the Advanced Solid Rocket Motor and the Extended Duration Orbiter capability.

- Space Station Freedom. -- Space Station Freedom is the largest international R&D project ever undertaken. In FY 1989, the program underwent a reevaluation that has resulted in a more achievable program and funding profile. The FY 1991 budget continues the President's commitment to the Space Station by proposing a total of $2.6 billion, an increase of 36 percent. This will provide for the critical transition from design to actual fabrication.

- Moon/Mars Exploration. -- On July 20, 1989, the President proposed that America undertake an ambitious mission of manned exploration of the solar system. This journey will begin with the first step in the FY 1991 budget towards this new goal -- nearly $1.3 billion, an increase of 47 percent -- to support robotic science missions and to develop the pacing and innovative technologies that will be needed. Of particular interest is the continued commitment of the Administration to

President announced U.S. support for a worldwide phaseout of chloroflurocarbon (CFC) production to the extent safe substitutes are available. In 1990, the U.S. will host the Plenary Session of the Intergovernmental Panel on Climate Change (IPCC) in February; a meeting of the world's economic, scientific, and environmental officials to discuss global environmental issues in the Spring; and the first negotiation session on the Framework Convention on Climate Change in late Fall.

F. Environment

- Clean Air Act. -- The President demonstrated his commitment to clean air by transmitting Clean Air Act Amendments to Congress in July 1989. The President's plan allows for both environmental protection and economic development and is based on a commitment to using the best science available. In support of his Clean Air proposals, the FY 1991 air research budget of the Environmental Protection Agency will increase by $8 million to a total of $95 million.

G. The Superconducting Super Collider and High Energy Physics

- The Superconducting Super Collider (SSC). -- The SSC will provide an enormous advance in the capability to explore the secrets of matter and energy. Over the past year, the Department of Energy has established the SSC laboratory at a site near Dallas, Texas. The new laboratory team is conducting a thorough reevaluation of all technical systems with particular attention to magnet design and technical performance of the accelerator. In FY 1989, research continued on the design and testing of magnets. Approximately 8,000 magnets will be used in the 53-mile SSC tunnel. In addition, during FY 1989, DOE continued work on the site-specific Environmental Impact Statement (EIS). The EIS is necessary before DOE makes a decision on the "footprint" of the SSC and starts acquiring land for the project.

- High Energy and Nuclear Physics. -- The President supports a robust program of research in the areas of high-energy and nuclear physics, which offer the prospects of increasing our knowledge of the basic constituents of matter. Last year, will spur further advances, as will initiatives that improve payoffs on investments. The FY 1991 budget proposes $3.6 billion for biotechnology R&D, an increase of 6 percent over 1990.

- <u>Agricultural Research Initiative</u>. -- American farmers are among the most productive in the world. New techniques in genetics, molecular and cell biology have led to innovative approaches that will enhance our ability to produce food, while addressing concerns of safety, nutrition and the environment. The FY 1991 budget will launch a National Research Initiative to more than double the size of USDA's competitive grants program. This will expand funds for plant and animal biotechnology to $50 million, with a particular emphasis on mapping the genome of important crop plants. Like the Human Genome Initiative, this effort will create new opportunities to explore the genetic potential of plants.

I. <u>Energy</u>

- <u>National Energy Strategy</u>. -- The President has directed Secretary of Energy Watkins to develop a National Energy Strategy to guide the Administration's energy policies and programs. The Department has held two rounds of public hearings and plans to issue a draft document in April. A key element of the strategy will be a blueprint for future energy R&D programs and activities.

- <u>Clean Coal Technology</u>. -- The Administration is committed to a $2.5 billion program to demonstrate emerging clean coal technologies. This program will provide additional cost-effective alternatives for reducing acid rain.

- <u>Solar/Renewables and Energy Conservation R&D</u>. -- The President is committed to assisting the development of emerging technologies that offer the potential to provide new sources of energy as well as new ways to use it more efficiently, while protecting the environment. On January 26, 1990, the Department of Energy announced a new 11-point initiative in this area. The FY 1991 budget provides an increase of 8 percent in funding for conservation, solar and other renewable energy technology R&D.

emerging technology, an increase of almost 400 percent. These efforts are being carried out by both the Department of Transportation (about $6 million) and the Army Corps of Engineers (almost $4 million). Each agency is pursuing a public-private partnership designed to facilitate private development of an operational maglev system in the U.S.

K. National Security

- DOD Technology Base. -- The President supports a strong technology base to develop options for future weapons systems and to guard against technological surprise by adversaries. The FY 1991 budget includes $3.4 billion for the technology base (basic and applied research) funded through the Department of Defense. This will support programs ranging from basic research in the physical sciences to development of high-speed semiconductors for use in advanced communications systems and computers.

- Strategic Defense Initiative (SDI). -- The SDI program remains a high priority of the President. The FY 1991 budget requests $4.5 billion for SDI, an increase of $0.9 billion over 1990. The SDI program is developing options for strategic defenses based on advanced technologies. Particular emphasis is being placed on promising new concepts such as the "Brilliant Pebbles" small space-based interceptor missiles.

III. Encouraging Increased Private Sector R&D Investment

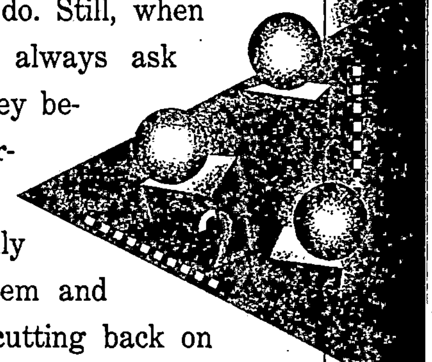
Private sector investment accounts for about 50 percent of the total national investment in R&D. In addition, the private sector is the principal performer for R&D and is ultimately responsible for transforming R&D results into useful new products and processes. The Administration has taken a number of steps to encourage increased private sector R&D investment and technological innovation.

- Encouraging Savings and Investment. -- The President is proposing the Family Savings Account to stimulate increased savings that provide the resources needed for investments in the future. In addition, the President is proposing to lower the tax on capital gains in order to promote increased entrepreneurial activity and investment.

NO DOUBT ABOUT IT: THE MORE YOU RESEARCH, THE BETTER YOU DO

HOW R&D SPENDING PAYS OFF

YOU'RE A FAR-SIGHTED EXECUTIVE. You believe in R&D. While you know that the phenomenally successful breakthroughs—instant photography, xerography, the transistor—come only as frequently as Halley's Comet, you invest in research and development anyway. Even little advances help, you reason, and, well, it just seems a smart thing to do. Still, when the crunch comes, you always ask yourself: Is all that money being spent by those mavericks in the lab really worth it? Does it actually make sense to spare them and their toys when you're cutting back on marketing and laying off in production?



A statistical analysis that BUSINESS WEEK commissioned of historical data from its R&D Scoreboards suggests the answer is an unqualified "Yes." The study, done to improve the format for the Scoreboard, demonstrated beyond any doubt that the companies with the strongest performance in their markets are also the ►

R&D IN 1988

TOTAL INDUSTRY SPENDING: **$59.4 Billion** CHANGE FROM 1987: **+11%**

R&D AS A PERCENT OF SALES: **3.4%** CHANGE FROM 1987: **None**

R&D AS A PERCENT OF PRETAX PROFITS: **39.4%** CHANGE FROM 1987: **–2.3** PERCENTAGE POINTS

INDUSTRIES THAT INCREASED R&D THE MOST:

1.	**NONBANK FINANCIAL**	27%
2.	**HEALTH CARE**	19
3.	**OFFICE EQUIP. & COMPUTERS**	18
4.	**ELECTRICAL & ELECTRONICS**	13
5.	**AUTOMOTIVE**	12

INDUSTRIES THAT INCREASED R&D THE LEAST:

1.	**METALS & MINING**	–2%
2.	**HOUSING & CONSTRUCTION**	0
3.	**AEROSPACE**	1
4.	**CONGLOMERATES**	2
5.	**FOOD**	3

THE TOP COMPANIES IN 1988 R&D SPENDING

The parentheses after the company names show the industry group in which the company appears in the Scoreboard tables that start on page 180.

In Total Dollars (millions)

1.	**GENERAL MOTORS** (2a)	$4,754
2.	**IBM** (16c)	4,419
3.	**FORD MOTOR** (2a)	2,930
4.	**AT&T** (19)	2,572
5.	**DU PONT** (3)	1,319
6.	**DIGITAL EQUIPMENT** (16c)	1,307
7.	**GENERAL ELECTRIC** (4)	1,155
8.	**EASTMAN KODAK** (12)	1,147
9.	**HEWLETT-PACKARD** (16c)	1,019
10.	**UNITED TECHNOLOGIES** (1)	932

As a Percent of Sales

1.	**AMGEN** (10a)	89.5%
2.	**CENTOCOR** (10a)	61.3
3.	**ALZA** (10a)	39.7
4.	**GENENTECH** (10a)	34.6
5.	**CONTINUUM** (16g)	29.0
6.	**EVANS & SUTHERLAND** (16g)	28.6
7.	**HOGAN SYSTEMS** (16g)	27.2
8.	**BMC SOFTWARE** (16g)	26.9
9.	**CYPRESS** (7d)	24.2
10.	**CULLINET SOFTWARE** (16g)	24.2

In Dollars Per Employee

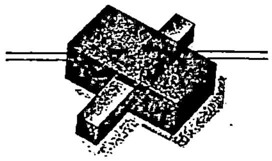
1.	**AMGEN** (10a)	$112,269
2.	**CENTOCOR** (10a)	78,658
3.	**GENENTECH** (10a)	64,037
4.	**CHIPS & TECHNOLOGIES** (7d)	60,828
5.	**WEITEK** (16f)	45,717
6.	**ALZA** (10a)	45,578
7.	**BMC SOFTWARE** (16g)	42,622
8.	**BOLAR** (10a)	41,273
9.	**ALLIANT COMPUTER** (16c)	36,638
10.	**ASHTON-TATE** (16g)	36,208

DATA: STANDARD & POOR'S COMPUSTAT SERVICES INC.

ones that spend the most, pound for pound, on R&D. So, for the first time, the tables rank the companies within their industry subgroups by a key variable for indicating future corporate performance: R&D spending per employee.

Although earlier studies have suggested a tie between R&D spending and performance, probably none was based on as broad a sample as is represented by the BUSINESS WEEK R&D Scoreboard. This year's tables, which begin on page 180, include 897 companies in 40 industry groups and subgroups. The grand total of R&D spending in 1988 by all the companies covered was almost $59.4 billion, an 11% increase over the comparable 1987 number. Even adjusted for the inflation in nonresidential capital investments, the increase was more than 6%.

The statistical analysis that led to the new ranking system was done by mathematician and computer consultant Robert Reithner, based in Hoboken, N.J. Working with data provided by Standard & Poor's Compustat Services Inc., Reithner was asked to gauge what, if any, correlation he found between three measures of company performance (profit margins, return on assets, and sales per employee) and two measures of R&D spending (per dollar of sales and per employee). To approximate the real-world lag between R&D outlays and results, he was asked to compare company performance in 1987 with average R&D spending from 1983 through 1986.



THE RESULT FOR ONE PAIR OF THESE VARIables was eye-popping: "The rank correlation between R&D per employee and sales per employee is off the scale," states Reithner in his report. The statistical significance that he calculated for the correlation between the two sets of rankings was well beyond 99.9%. Although he found no significant correlation between R&D spending per employee and return on assets, the correlation with corporate profit margins was also undeniable: a statistical significance in excess of 99.5%.

With that, the decision to include rankings in the Scoreboard came easily. In addition to placing the companies in each subgroup by their 1988 R&D spending per employee, the tables also rank them by average R&D spending per employee for the five-year period from 1984 through 1988. And along with the customary listings of R&D as a percent of profits and as a percent of sales, the tables now give each company's sales per employee.

As with any set of statistics, it's important to keep some limitations in mind. The first is that you can't compare R&D spending per employee of companies in different industries, or even different subgroups within a given industry. This can be especially misleading when you are comparing a company in a high-tech industry with one in a mature old-line business. The $36,638 in R&D that Alliant Computer Systems Corp. spent per employee in 1988 actually tells you little when stacked against the $2,878 per employee spent by fabric maker Concord Fabrics Inc. It's only after you notice that Concord spends fives times the average for its group, vs. less than 3½ times for Alliant, that you can appreciate how aggressive Concord is about research. Relative to the environment in which it operates, Concord actually outspends Alliant.

That's why the tables on this page list some of the companies that spend significantly more on R&D per employee than the other companies in their respective subgroups. In theory, these numbers should be comparable across industry groups. Even these, however, must be read in perspective. DeKalb Genetics Corp., for example, leads all 897 companies in the Scoreboard by this measure. One reason is that, although DeKalb is grouped with food companies, it also has a large bioengineering operation—where especially heavy research spending is typical. But because DeKalb is one of the leading suppliers of hybrid corn seed, it's ranked as a food company in the government's standard industrial classifications.

Another caveat to keep in mind when interpreting the data: Usually, a company's ranking for R&D spending per employee in 1988 correlates quite well with its ranking for the average spent per employee for 1984 through 1988—but not always. Triton Energy Corp., for example, leads the Oil, Gas & Coal group with $5,945 spent per employee in 1988. In contrast, Chevron Corp.'s ratio of $3,875 placed it eighth out of 14. But Chevron ranks No. 1 in spending for the past five years, while Triton ranks ninth. What's more, Chevron leads the group in five-year spending by a wider margin than Triton leads those in the one-year grouping. Is Triton on its way to becoming the group's new R&D star? Or was this year's ratio just a fluke?

The most critical caution, however, is that there simply is no way to establish statistically that it's R&D spending that results in greater sales per employee—and not the reverse. Although BUSINESS WEEK built a lag into the comparisons when it had the historical data analyzed, this ad hoc refinement to the exercise is, in itself, hardly conclusive. "Statistics can never establish causality," notes Reithner. "You have to bring your own theory to the figures to do that." He offers this analogy: If you charted the use of air conditioning vs. temperature, you would no doubt see that the hotter it gets, the more that people turn on their cooling units. But that correlation, no matter how close, doesn't tell you which caused which. Common sense does.

And what does common sense suggest about R&D spending per employee vs. sales per employee or profit margins? Which came first? Reithner doesn't hesitate: "From my observations of high-tech companies, it seems pretty clear to me that R&D drives sales and profits—not the other way around."

By Anthony J. Parisi in New York

THE LEADERS' LEADERS

The following companies not only spent a lot on R&D per employee but also a lot more than their competitors. To arrive at this list of the companies most committed to research, BUSINESS WEEK first split off the three companies with the greatest R&D spending per employee in each of the 40 industry subgroups covered by the Scoreboard. We then calculated the percentage by which their spending per employee exceeded the composite figure for the group. We did this for 1988 spending and for spending from 1984 through 1988. These percentages determined the rankings. The parentheses after each company's name indicate the subgroup in which that company appears in the Scoreboard tables.

Based On Spending In 1988 . . .

1.	**DEKALB GENETICS** (8)	1,152%
2.	**PIONEER HI-BRED** (8)	1,088
3.	**LAM RESEARCH** (13c)	776
4.	**AMGEN** (10a)	729
5.	**CHIPS & TECHNOLOGIES** (7d)	715
6.	**APPLIED MATERIALS** (13c)	664
7.	**GRADCO SYSTEMS** (16a)	560
8.	**FILENET** (16a)	545
9.	**WEITEK** (16f)	522
10.	**QUANTUM** (16e)	495
11.	**CENTOCOR** (10a)	481
12.	**SILICON VALLEY** (13c)	469
13.	**FRANKLIN COMPUTER** (16a)	431
14.	**SEI** (15)	393
15.	**CONCORD FABRICS** (13d)	385
16.	**GENENTECH** (10a)	373
17.	**VARCO** (9b)	367
18.	**SYMBOLICS** (16f)	350
19.	**PLAYTEX** (5c)	316
20.	**TORO** (5a)	315
21.	**DIGITAL MICROWAVE** (7b)	306
22.	**ARITECH** (18)	302
23.	**DST SYSTEMS** (15)	299
24.	**LTX** (7c)	293
25.	**CALGON CARBON** (18)	291

. . . And For The Last Five Years

1.	**DEKALB GENETICS** (8)	626%
2.	**CHIPS & TECHNOLOGIES** (7d)	586
3.	**PIONEER HI-BRED** (8)	534
4.	**LAM RESEARCH** (13c)	464
5.	**APPLIED MATERIALS** (13c)	449
6.	**AMGEN** (10a)	448
7.	**GALOOB (LEWIS) TOYS** (12)	403
8.	**WEITEK** (16f)	388
9.	**DIGITAL MICROWAVE** (7b)	354
10.	**TORO** (5a)	344
11.	**GRADCO SYSTEMS** (16a)	333
12.	**CENTOCOR** (10a)	327
13.	**EARTH TECHNOLOGY** (18)	297
14.	**SILICON VALLEY** (13c)	292
15.	**FILENET** (16a)	287
16.	**VARCO** (9b)	286
17.	**ALTERA** (7d)	275
18.	**VIPONT** (5b)	259
19.	**ACUSON** (10b)	232
20.	**PHEONIX TECHNOLOGIES** (16h)	228
21.	**FRANKLIN COMPUTER** (16a)	224
22.	**3M** (13a)	220
23.	**VARITRONIC** (13a)	217
24.	**GENENTECH** (10a)	209
25.	**POLAROID** (12)	207

DATA: STANDARD & POOR'S COMPUSTAT SERVICES INC.

A Conversation with D. Allan Bromley

The President's science adviser is determined to bring science and technology into a broad range of national policy issues

ALL SCIENCE is not created equal. That's the way D. Allan Bromley sees the world and that's what he says will define his role as science adviser to George Bush. "Quite frankly, some research is better than others. If the President of the United States is going to use scientific information for policy-making, I have to help him judge how reliable it is," Bromley declared in a recent interview with *Science*. "My job . . . is to be an honest broker."

Just 2 months after taking over as head of the White House Office of Science and Technology Policy (OSTP), Bromley has settled into his job with the air of a man who is intent on making his mark on Washington. In stark contrast to William Graham, his nearly invisible predecessor in the Reagan Administration, Bromley is taking a visible role as President George Bush's man for science.

Ken Heinen

Allan Bromley: *"Science is not an afterthought," in the Bush White House.*

"The President has really bent over backwards to be supportive," said Bromley, who was named an "assistant to the President." In title-conscious Washington, that ranking elevates the status of the OSTP directorship and puts Bromley on a par with the National Security Adviser. During a long talk in his office in the Old Executive Office Building, Bromley also said he has good relations with White House Chief of Staff John Sununu.

Bromley, who was not named science adviser until the Administration had been in office for 4 months, was initially concerned that he would have a hard time fitting into a White House staff that was already in place. But he reports that, from his point of view, this has not been a problem.

Bromley, who describes himself as both physicist and engineer, is comfortable with the engineer in Sununu, who was a professor at Tufts before moving into politics. "Sununu has an instinct for asking the right question," Bromley observes. "He has an engineer's ability to approximate and to rapidly calculate orders of magnitude—to ask, 'Is this reasonable?' It is an important quality in policy-making where you don't always need a scientist's precision."

As assistant to the President, Bromley has a seat on a number of White House bodies, including the economic policy council, the domestic policy council, the space council, and the competitiveness council. "It means that I routinely sit in on a full range of meetings," says Bromley, "and expect to bring science to the table before policies are otherwise worked out. In this White House, science is not an afterthought."

Clearly, Bromley is in his element. The 63-year-old professor from Yale has spent years preparing for this role as an author of science policy papers, as president of the AAAS, and as a member of the White House science council since 1981—an institution that will be reincarnated as the President's Council of Advisers on Science and Technology (PCAST). A list of candidates for the council was agreed upon before Bromley officially took office but, as yet, no one has been named. This, Bromley says, is because of generic conflict-of-interest issues that were raised recently regarding scientists on federal advisory panels (7 July, p. 20 *Science*). "We've spent a lot of time talking with our lawyers about the rules governing advisers and think we have things worked out. I expect we'll be able to announce PCAST appointments very soon." President Bush has said he will sit in on some of the council's meetings.

What are the most important issues on OSTP's agenda?

Fresh back from the "education summit" at which the President and the nation's 51 state governors spent 2 days setting goals for America's schools, Bromley put education first on his list. "The decisions to set national performance goals and to give the classroom back to the teacher are terribly important," said Bromley, adding that "in a great many cases, precollege education in the past decade has been literally perpetrating a fraud on the younger generation" by turning out students who cannot add and cannot read.

Bromley sees a shortage of "technicians" as one of the country's major challenges in education. "We still lead the world in basic research, but we fall apart when it comes to manufacturing. We focus on revolutionary developments, where the Japanese focus on evolutionary improvements. With even a small advance in manufacturing techniques, they can capture the market." Why? "Japan produces bachelor's graduates who are good at synthesizing materials, for instance; people very good in a narrow range. We're not educating enough of those people."

Bromley looks to the private sector to play a greater role in educating the work force. "We can't just rely on the school system," he observes, and suggests that industry take a lesson from the military, which has long experience in training people "who are not notably motivated." For instance, "The military uses computers extensively and effectively to teach people routine things. That expertise should be exploited."

In recent years, OSTP's greatest activity has been in military affairs. Former science adviser George Keyworth, for example, devoted enormous effort in promoting the much criticized Star Wars defense system. Will the Bromley OSTP play a major role in military affairs? "Certainly, OSTP will be active in certain areas but we'll have to be selective if we're not to be swamped by military issues." Bromley's first substantive meeting with Defense Secretary Richard Cheney is scheduled for this week.

What else is on the OSTP agenda? "The global environment," says Bromley, who has discussed this issue personally with President Bush. "The environment has moved to the world stage politically. Science and technology input are critical to policy here. This is an area where we really need solid information on the assumptions behind various environmental initiatives—a place where OSTP's role in evaluating the 'reliability' of data will be vital."

Bromley cites drugs—"There is a lot we don't know about addiction"—and AIDS as obvious areas of concern to his office, but he also expects OSTP to play a role in what he sees as one of the greatest crises of the next decade—life-extending technology. "We are rapidly approaching the time when we are going to have to withhold technology from some of the dying," Bromley told *Science*. "And we don't even have a fully developed value system for even beginning to figure out how to do that ethically." This, Bromley argues, is an area in which basic science and technology must "make common cause" with the "social sciences, with humanists, and with religion."

Before taking office Bromley recognized that if OSTP is going to be in a position to influence national policy, let alone take the lead, he would have to have staff and resources that surpassed those of his predecessors. In that he appears to be successful. Bromley has turned to senior hands to staff three of the four "associate director" positions he has created.

To fill the biomedical post—a long neglected area in OSTP—Bromley has recruited James B. Wyngaarden, former director of the National Institutes of Health. J. Thomas Ratchford, associate executive officer of the AAAS for the past dozen years, is slated to be Bromley's right-hand man for policy and international affairs. And the word around town is that Berkeley engineer Eugene Wong will be nominated as associate director for physical sciences and engineering.

That leaves just one top post vacant and Bromley acknowledges that he is having a tough time finding a seasoned researcher/administrator from industry to head activities related to industrial technology. "The problem is not comparatively low federal salaries," Bromley says. "People who want to perform government service can live with that. But the new financial disclosure and divestiture requirements make it very hard to attract the best people. It will just take time," he says.

Meanwhile, Bromley is busy going about his business of getting to know everyone he can in Washington and letting them know he wants to hear from them. A series of breakfast meetings with members of Congress has gotten under way, with help from the "science" members of the Senate—Al Gore, Jay Rockefeller, John Danforth, Jeff Bingaman, and others. Bromley has met with congressional staff members and he meets regularly with Richard Darman, director of the Office of Management and Budget, so that "OSTP is part of the budget process from the start of the cycle."

All in all, one of Bromley's main tasks right now is "building bridges," and he is going about it with a will.

■ BARBARA J. CULLITON

Plan for Genome Centers Sparks a Controversy

NIH is planning to set up targeted research centers to map and sequence the genome—a move that is setting off alarms among biologists

San Diego

IN JULY, the genome office at the National Institutes of Health took its first, halting step into the era of "big" biology. It announced that it would create special labs or centers, each with perhaps 25 investigators, to puruse the task of mapping and sequencing the human genome. What that means is that a good share of the genome project's budget—eventually half, predicts James Watson, the project's director—won't go to investigator-initiated science but to these new centers.

That's enough to send shivers throughout much of the biological community.

"Jim Watson is trying to change the social fabric of science. It's World War II and directed science all over again," grumbled one participant at a recent NIH workshop on centers.

Not so, responds Watson, who says he is simply trying to get the job done. The "job" is to map the chromosomes within 5 years and to decipher the full nucleotide sequence, all 3 billion base pairs, within 15 years—and at a total cost of no more than $3 billion. "If we go along the way NIH usually does, it could easily take 100 years to get the sequence," said Watson, who outlined NIH's plans in San Diego last week at the Human Genome 1 meeting sponsored by *Science*. Moreover, the cost of doing business as usual would be prohibitive. "We really owe it to the scientific community to keep the cost down," he said.

"People want to do this with a cottage industry approach," Watson told *Science*, "but I don't think it will work. I'm not trying to take away RO1s [investigator-initiated grants] but to create something new."

Many scientists aren't impressed. Since NIH issued its request for applications, Watson and his staff have been inundated with complaints. Some investigators oppose centers outright. Others agree with Watson that something different is needed for the genome project, but don't believe that these centers, at least as originally proposed, are it. And there is lots of grumbling about whether it is wise to invest all that money in a few groups (especially if yours is not among them).

The complaints seem unlikely to deter institutions from lining up for a piece of the pie. Some 20 teams showed up at the recent NIH workshop for grant applicants, suggesting that competition for the first three grants for next year will be fierce.

Watson cites both Cold Spring Harbor Laboratory, where he remains as director, and MIT's Whitehead Institute as evidence that centers can work. But he acknowledges that some units set up to fight the war on

© Margot Bennett

James Watson: *"We all know how fraudulent most centers are."*

cancer have poor reputations. With his characteristic bluntness, he told the workshop attendees: "We all know how fraudulent most centers are."

Norton Zinder of Rockefeller University, who chairs the NIH genome advisory board, matched Watson's outspokenness: The issue, he told *Science*, is how to avoid creating a monster—and how to kill it if you do. "In the past, centers were like werewolves—you couldn't kill them. And a lot of them go bad."

That makes decisions on how to structure these centers and ensure accountability ex-

ANALYSIS

BANK REFORM

There are at least 130,000 reasons why the Bush administration's sweeping plan to reform U.S. banking, unveiled last week, will run into trouble when it hits Capitol Hill later this month. America's independent insurance agents, who number about that many, will battle President Bush's proposal to let national banks compete with agents by selling insurance products in states that allow it. The agents make up just one of the numerous interest groups—including many small banks, some securities firms, pension funds and even bank regulators—opposed to portions of the plan, which would be banking's broadest overhaul in half a century.

Despite the objections, Congress could still pass many provisions of the proposal after what is expected to be up to a year of haggling over the details. Problem loans and mounting bank failures have highlighted the need to reform deposit insurance, attract new capital into banking and create a smaller, stronger industry. That should make it easier to dismantle anachronistic barriers to full interstate banking. Lingering opposition to allowing affiliations among banks, securities firms and commercial companies might also be squelched. To avoid a repeat of the S&L fiasco, however, Congress will demand safeguards to prevent banks from using insured deposits to fund risky nonbanking ventures. Lawmakers also want to move fast to replenish the strained Bank Insurance Fund and forestall a taxpayer bailout of failing banks.

For all the carping, many bankers think the Bush plan could go a long way toward curing much of what ails the troubled industry. "I'm not going to sit here until the perfect bill is available 10 years from now, when there's not going to be any American bank left," says Thomas Theobald, chairman of Chicago-based Continental Bank.

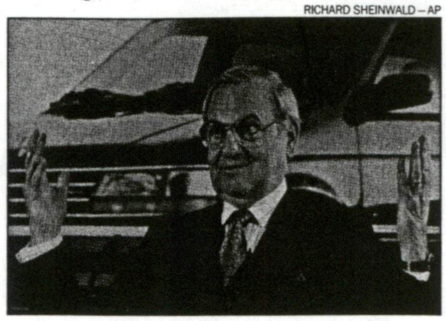
BY SUSAN DENTZER

BUSINESS

HITTING THE WALL IN DETROIT

Even good news from Detroit cannot hide the fact that 1991 is shaping up as a dismal year for American auto companies. In a rare surprise, Chrysler reported that it netted $31 million on $7.6 billion in sales in the fourth quarter of 1990. But bad days lie ahead. Chrysler said sales of its very profitable minivans plunged 60 percent in January. Worse still, *Consumer Reports* warned that an automatic transmission used in many minivans is a lemon. The article, says Chairman Lee Iacocca, "could drive us out of business." Standard & Poor's has added injury to insult by downgrading Chrysler bonds to junk status. The good news from General Motors—its European operations outsold Ford for the first time ever—was overshadowed by the word that GM will cut its white-collar staff by 15,000 and its dividend by 47 percent. Ford and Chrysler have retained their dividends, but analysts question the wisdom of payouts to stockholders when no profits are likely in the months ahead.

RICHARD SHEINWALD—AP



Mixed signals. *Chrysler's Lee Iacocca*

THE DOLLAR TAKES A DIVE

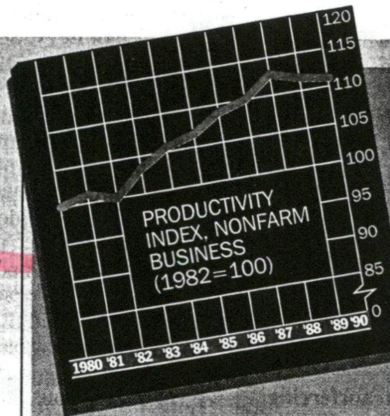
The precipitous drop of the American dollar against major foreign currencies is not necessarily bad news for the recession-wracked economy. The record lows the dollar hit last week against the German mark and the Swiss franc and its lost ground to the Japanese yen promised to give domestic exports a boost. "American manufacturers are now hypercompetitive compared to those in Europe," declares David Rolley, senior financial economist at DRI/McGraw-Hill. Ordinarily, an anemic dollar would feed inflation by increasing the cost of imports. But because of the recession, foreign companies are either unable or unwilling to boost prices on cars, TVs and other items. Overall, says Shafiqul Islam, senior fellow at the Council on Foreign Relations, "this is not a bad time for the currency to fall."

MONEY CLIP

America is getting less production from its workers, but the manufacturing sector is holding up well.

■ Change in manufacturing output:
1990: +0.8%
1982: –6.5%
Overall (nonfarm) output, 1990: +0.2%

■ Manufacturing output as a percentage of GNP:
1990: 23.3
1982: 20.0 (post-World War II low)



USN&WR—Basic data: U.S. Dept. of Labor

PRODUCTIVITY PLUNGE

The percentage decline in output per employee hour mirrors the 1982 recession.

■ Manufacturing industries with greatest productivity increases in 1989:
Metal-cutting machine tools: 25.8%
Rice milling: 21.7%
Greatest decreases:
Copper rolling: –5.5%
Wood office furniture; lawn equipment: –5.2% each

■ Manufacturing productivity:
1980, U.S.: –0.7%
Japan: +6.9%
1989, U.S.: +3.3%
Japan: +5.8%

BUSINESS

PHOTOFEST

Everybody knows their name. *A scene from residual-rich "Cheers"*

THE NETWORK-STUDIO RERUN RUNAROUND

It is one of the longest running soaps—but you won't see it on television. It has been playing at the Federal Communications Commission for more than 20 years. The plot pits the three major TV networks against the film studios in a battle over who gets to cash in on the bonanzas from syndication of hit series. (Rerun rights for "The Bill Cosby Show," for example, brought a record $600 million.) The dispute could determine how much free vs. fee programming will appear on television.

The networks—largely cut out of the resale action since 1970, when the so-called financial interest and syndication rules were passed—have tried to get these rules repealed. The production companies claim that giving the networks the right to make, own and resell shows would kill off Hollywood's independent producers.

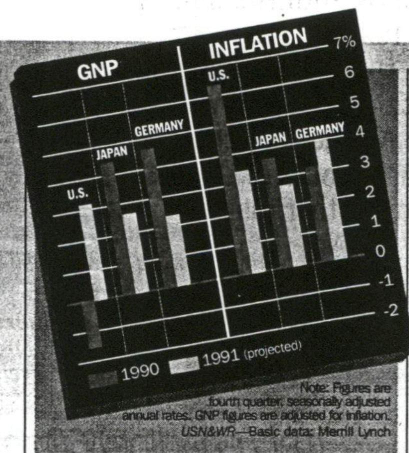
Last week the FCC, in effect, cut the baby in half in a 3 to 2 ruling that left both sides crying foul and threatening to ask for a rehearing. The networks got more-liberal syndication rights, but they were hedged with new restrictions, which still left the studios sitting pretty. Fox Broadcasting emerged the only clear-cut winner; the FCC said the fledgling fourth network was free to produce, broadcast and syndicate shows with almost none of the limitations constraining CBS, NBC and ABC.

MONEY CLIP

U.S. CATCHING UP WITH RIVALS

■ **Projected 1991 long-term interest rates:**
U.S.A.: 9.2%
Germany: 8.8%
Japan: 6.8%

■ **Trade balance, in U.S. billions:**
1990 actual
Germany: $51.9
Japan: $35.8
U.S.A.: –$94.9
1991 projected
Japan: $27.1
Germany: $25.0
U.S.A.: –$25.5



Comparisons of projected 1991 GNP and inflation rates show the U.S. improving its position in the international arena.

■ **Fourth quarter 1990:**
$1.00 = 131 yen
$1.00 = 1.5 marks
Projected fourth quarter 1991:
$1.00 = 145 yen
$1.00 = 1.75 marks

■ **Projected 1991 unemployment rates:**
Germany: 8.3%
U.S.A.: 7.5%
Japan: 2.2%

■ **Average amount workers save for every $1.00 earned:**
Japan: 16¢
Germany: 10¢
U.S.A.: 5¢

CALENDAR

Rain man ▪ On October 8, the artist Christo will coordinate the popping open of $26 million worth of giant umbrellas—1,340 blue ones 75 miles north of Tokyo and 1,760 yellow ones 70 miles north of Los Angeles. The 28-foot-wide umbrellas, which will remain up for three weeks, are positioned in topographically similar landscapes to evoke the parallels between the two countries.

Financial times ▪ On October 15, the International Monetary Fund and the World Bank will kick off their annual meeting in Bangkok. The main topics for the 3,000 delegates from 159 countries will range from world economic forecasts to loans for the Soviet Union.

Lucky lotto ▪ From October 14 to 20, the U.S. State Department will hold a mail-in lottery to award 40,000 permanent visas to natives of 34 countries, mostly in Europe. As part of an effort to counteract bias from a 1965 immigration law, Irish applicants will get 16,000 of the visas.

DATABASE

Immigrants expected to participate in the lottery: **5 million**

Visas granted European immigrants in 1965: **117,090;** in 1990: **44,839**

Immigration visas issued in 1980: **331,345;** in 1990: **437,768**

Applicants on immigration waiting lists in 1981: **1.1 million;** in 1990: **2.4 million**

Countries with most people on waiting list: **Philippines, Mexico, India**

Country granted the most visas in 1990: **Philippines (44,112);** the fewest: **San Marino (0), Liechtenstein and Rwanda (1), Monaco (2)**

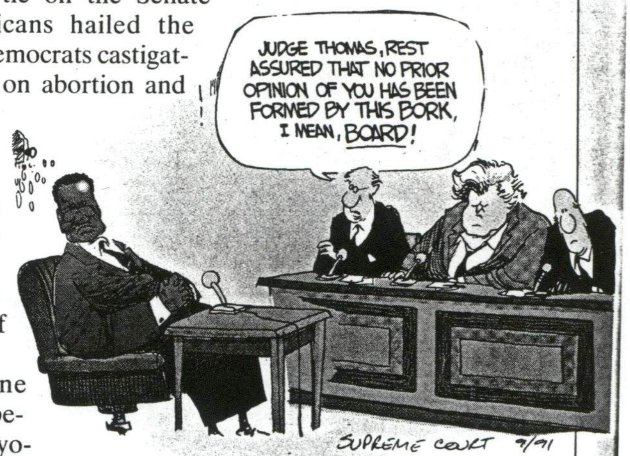
Applications for asylum in 1990: **73,637;** granted: **5,672;** backlog: **97,288**

Illegal aliens caught in 1990: **1.1 million;** deportations in 1989: **859,521**

U.S. NEWS

ONE JUDGE AND A SPLIT SENATE

Crucial Senate votes have a way of approximating public opinion, and the judgment on Clarence Thomas's Supreme Court nomination seems headed that way: narrow approval. Spirited debate over the black conservative's credentials and philosophy resulted last week in a 7-to-7 tie on the Senate Judiciary Committee. Republicans hailed the judge's rise from poverty while Democrats castigated his refusal to state his views on abortion and other legal issues. His fate on the Senate floor lies with Southern Democrats, who provided the margin against Robert Bork in 1987. Louisiana's John Breaux announced support for Thomas, but Alabama's Howell Heflin came out against him, citing a "lack of conviction and instability."



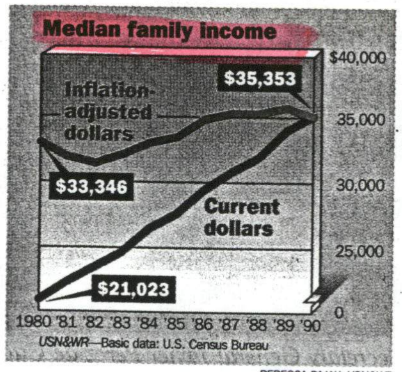
Most senators agree on one thing: Court confirmations have become unseemly spectacles. Wyoming Republican Alan Simpson suggested the panel meet privately with future nominees to avoid acrimony that would create a "free fall into mediocrity." Democrat Joseph Biden, chairman of the Judiciary Committee, agreed that the "cycle of politicization and skepticism" should be broken. He added that George Bush, when he chooses judges, could help by pursuing a "course of moderation."

MAYBE MONEY DOES HELP

The mountain of money the nation spent on education in the '80s, the White House has long argued, accomplished very little. But an analysis by government researchers paints a different picture. The unpublished study by the Sandia National Laboratories in Albuquerque, N.M., found that dropout rates declined in the past decade and are at an all-time low. Scores on the Scholastic Aptitude Test are down, the study adds, only because a wider range of students are finishing high school and taking the college admission test. When Sandia researchers briefed Republican senators on the report last week, Deputy Secretary of Education David Kearns showed up to argue that the study was flawed.

IN POVERTY: 34 MILLION AMERICANS

Economists knew the recession has been rough. Still, the magnitude of the Census Bureau numbers came as a surprise. The government's first close-up look at the nation's economic slump showed 34 million Americans living in poverty last year, 2.1 million more than in 1989. For the first time in seven years, the poverty rate increased, from 12.8 percent of the population to 13.5 percent. One in 5 children lived below the official poverty line, now set at $13,359 for a family of four. In addition, middle-income white families saw their earnings fall. Republicans insisted that the numbers reflected only a temporary slowdown. But with the hardships lasting well into this year, 1991's poverty data are likely to be dismal, too. Those statistics will come out before Election Day 1992.



REBECCA PAJAK–USN&WR

ILLUSTRATION: JENNIFER HEWITSON FOR *USN&WR;* CARTOON: S. WILLERS –*ORLANDO SENTINEL*

EYE ON THE '90s

It comes as little surprise that various enterprises have been affected by Clarence Thomas's hearings. Herewith, an informal look at who's up and who's down:

■ **X-rated videos** · A survey of 30 video stores in the Washington, D.C., area showed signs of interest in the works of porn star Long Dong Silver, although store spokesmen think the inquiries came mostly from reporters.

■ **Sexual harassment training videos** · Big winners. Ten distributors of the videos say interest has shot up. BNA Communications of Rockville, Md., reports that inquiries for its videos jumped 400 percent.

■ **Lawyers** · Attorneys across the country who specialize in harassment cases have seen noticeable increases in calls about the subject. Incidentally, men file complaints against women in a tiny fraction—approximately 2 percent—of sexual harassment cases.

■ **Yale Law School** · Although it is too soon to see effects on applications, the school has received a score of calls about the hearings. Some callers were trying to reach Clarence Thomas, one called to complain that a student had appeared on television in a wrinkled shirt and two were incoherent.

■ **"The Exorcist"** · Calls to 13 Washington, D.C., area bookstores turned up exactly one request for the novel. It is not known whether that call was from Orrin Hatch's office.

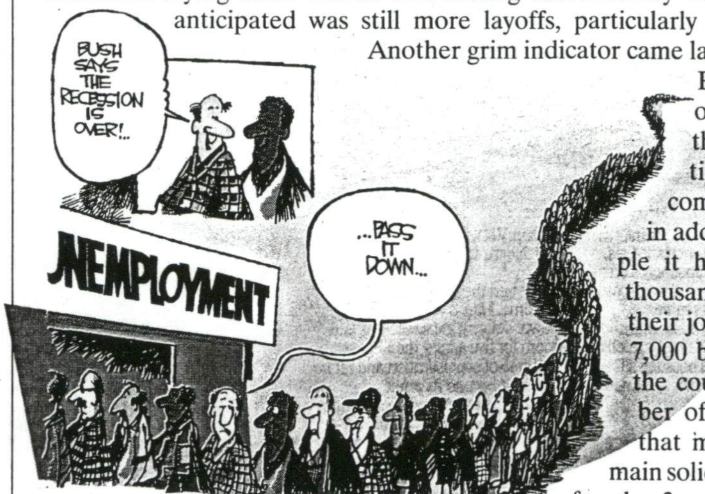
■ **Coca-Cola** · Americans may be eyeing their cola cans a little more closely, but the effect of Anita Hill's testimony on sales is likely to be negligible, according to numerous marketing experts. "This is a hazard," says a Coke spokesman, "when you're virtually ubiquitous."

BY AMY BERNSTEIN

BUSINESS

BUSINESS LEADERS EXPECT MORE LAYOFFS

"No one is saying the economy is healthy," President Bush's chief economic adviser, Michael Boskin, told business leaders, "but we believe it is improving." He was speaking at a closed-door session of the Business Council called to discuss ways of bolstering the economy. Participants were skeptical; the council put out a statement saying there was no real feeling that recovery was happening. What it anticipated was still more layoffs, particularly in the service sector.



Another grim indicator came last week from Citicorp. Reporting record losses of $885 million for the third quarter, the nation's largest banking company estimated that, in addition to the 5,000 people it has laid off this year, thousands more stood to lose their jobs. And in a survey of 7,000 business owners across the country, the U.S. Chamber of Commerce indicated that most hiring freezes remain solid—disappointing news for the 3 million Americans who have exhausted their unemployment insurance benefits this year.

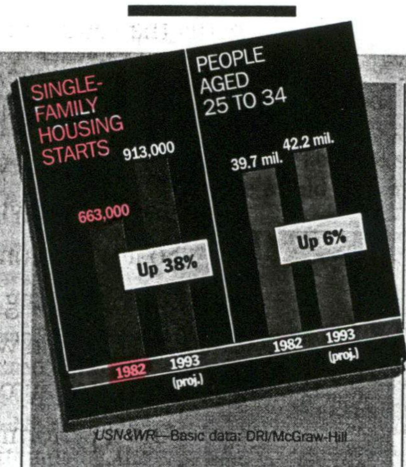
The president nonetheless cited economic recovery as one reason for vetoing the Democrats' bill to extend unemployment benefits beyond 26 weeks, the second such bill he has rejected. It would be a budgetbuster, he said. After failing last week to override the veto, the Democrats started work on a third bill and warned that the veto would be an election issue. Mindful of the government estimate that 3.4 million more jobless will use up their benefits next year, Republicans sought last week to introduce their own benefits-extension bill in the Senate. It aims at shorter extensions, with revenue-raising measures to meet the cost. Not pleased, the Democrats blocked its introduction and labeled it "a political sham."

MONEY CLIP

HONEYMOON ENDING FOR HOME BUYERS

■ THE PROBLEM
Despite a favorable market, few people are buying homes. Construction of new ones—housing starts—dropped 2.2% last month. In August, one-family starts outpaced sales of new one-family homes by 352,000.

■ TOMORROW
The market won't stay ripe for long. Analysts expect new-home prices to rise 8.8% in the next 12 months to average $165,300, and 30-year mortgage rates to go from 8.8% now to as much as 9.75%.



Who will buy? There may not be enough first-time home buyers to soak up the supply of houses, much less afford them.

■ THE DREAM?
By 2000, owning a home will cost 29% of household income—less than today's 31% but still higher than the 24% in 1970. With new-home prices expected to rise by 63%, it could be now or never for home buyers hunting bargains.

ILLUSTRATION: JACK DESROCHER FOR *USN&WR*; CARTOON: WALT HANDELSMAN—*TIMES-PICAYUNE*

CALENDAR

Dallas revisited • On November 14, nearly 28 years after the event, conspiracy buffs will meet in Dallas for a symposium on John F. Kennedy's assassination. Six books on the murder are due out soon, including "Three Days at Parkland," by a doctor who attended both Kennedy and Lee Harvey Oswald. In December, "JFK," Oliver Stone's already controversial movie, will be released.

Final exit • Congress hopes to finish this year's business before Thanksgiving. It must still deal with bank reform and new unemployment-insurance legislation.

Gifted children • On November 6, in Kansas City, the National Association for Gifted Children will meet. Programs include "Parents of Gifted Children: Friend or Foe?"

DATABASE

Children in the United States who are gifted: **2.3 million**

States with mandated special education programs for gifted kids: **26**

Average SAT score of college-bound high-school seniors: **896**

Minimum score of 13-year-olds entering Johns Hopkins Center for Talented Youth: **930**

High-achieving teens who rate their teachers' dedication as excellent: **8%**

Whose parents are still married: **78%**

Who drop out of high school: **20%**

Who own, or have a friend who owns, a gun: **45%**

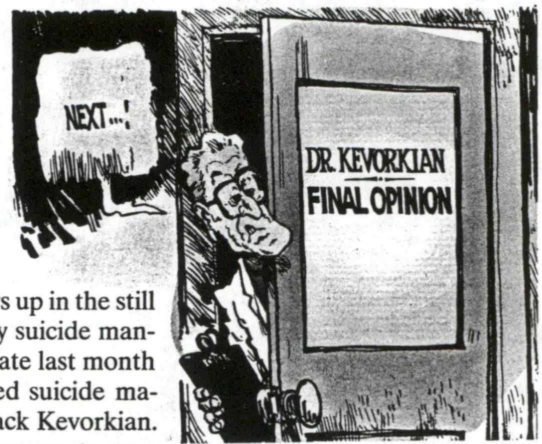
Who have considered suicide: **27%**

Formal education of
Thomas Edison: **3 months**
Abraham Lincoln: **12 months**

U.S. NEWS

THE VOTERS DEFINE A RIGHT TO DIE

Medical ethicists and lawmakers have failed to ease the dilemmas surrounding whether and when to apply lifesaving technology. So now citizens in Washington State, in a referendum, must decide for themselves whether they can ask a doctor to assist in their deaths. If Initiative 119 passes, Washington would become the first place in the world to legalize active euthanasia. (The practice is tolerated but illegal in Holland: article, Page 28.) If that happens, the United States could face a debate every bit as divisive as the abortion controversy.



Concern about the subject shows up in the still brisk sales of the Hemlock Society suicide manual, "Final Exit," and the deaths late last month of two Michigan women who used suicide machines created by "Dr. Death," Jack Kevorkian. But passage of Initiative 119, opponents warn, could lead to an even uglier situation: subtle pressure, imposed by doctors and families, on the infirm to ask to die rather than use up scarce health-care funds.

GOING OVERBOARD ON-LINE

Computer networks are becoming the nation's soapboxes, with people across the country speaking their minds electronically. But now there are lively debates about how free expression should be in the computer age. Prodigy, one of the nation's two largest computer networks, is facing criticism for trying to stop messages that it deems offensive. Recently, CompuServe, the other major network, was sued for libel by a rival computer company for carrying allegedly defamatory messages about one of the rival's products. Last week, in what legal experts call a precedent-setting case, a federal judge likened computer networks to public libraries, ruling that CompuServe is not liable for information running on its system. Despite the decision, Gerard Van der Leun, a lobbyist for computer networks, predicts that disputes aired on the nation's growing network systems are likely to increase, causing more libel suits.

HOW STEALTHY IS STEALTHY ENOUGH?

Congress has all but killed the B-2 Stealth bomber. For the second year in a row, Defense Department authorization legislation includes no money for new B-2s, which could very likely mean that the U.S. fleet will consist of only 15 Stealth bombers instead of the 75 that the Pentagon wants. Still, House and Senate committees have approved nearly $2 billion for repairs and have created a $1 billion B-2 escrow account, leaving open the remote possibility of building one more plane.

Despite the budget vote, the Pentagon still wants to make the B-2 work. After the plane flunked a recent radar-evasion test, a blue-ribbon panel was appointed to discover why. There are now hints that the Pentagon may certify the B-2's evasive capacity by lowering the test program's standards. The Air Force is studying whether the radar-evasion capabilities needed to foil Soviet defenses—no longer a high priority—are the same as those required against more likely foes such as Iraq. Another sign of a changed world: The committees set aside $1 billion from the defense budget for President Bush to use for humanitarian aid to the Soviet Union.

ILLUSTRATION: JENNIFER HEWITSON FOR *USN&WR*; CARTOON: BROOKINS—*RICHMOND TIMES-DISPATCH*; PHOTO: NORTHROP CORP.

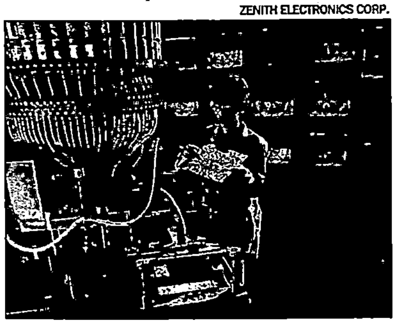
MIGRATION

THE LAST TV

It was one of the most visible symbols of America's postwar dominance: watching television on a set made by one of the American electronics giants like Westinghouse, Admiral or Motorola. But after years of faltering, that symbol has finally faded entirely. In 1968, 28 major American companies made televisions; now, only one remains: Zenith Electronics Corp. And last week, that sole survivor announced it is moving its assembly operations to Mexico. "It is the end of an era," says David Lachenbruch, editor of *Television Digest.*

Zenith's move is more symbolic than surprising; the company already makes about 50 percent of its televisions south of the border. Zenith claims that price wars in the U.S. market—where analysts estimate that half of televisions are sold almost at cost—have led to $500 million in lost revenues in the past five years.

ZENITH ELECTRONICS CORP.



In Mexico. *A Zenith factory*

Ironically, foreign companies continue to make televisions in the United States with familiar American brand names, including Holland's NV Philips Corp. (Magnavox, Sylvania), France's Thomson SA (RCA, General Electric) and Japan's Matsushita Electric Industries Corp. (Quasar). That situation poses a dilemma for U.S. consumers who prefer to buy American-made products. "Do you support Sony with its U.S. workers," asks labor official Robert Mingus, "or Zenith, now building its product outside the country?"

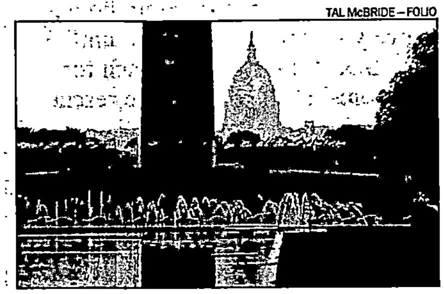
By Warren Cohen

BUSINESS

CARS OF THE 21ST CENTURY

Increasingly, the capital that decides what kinds of cars Americans drive and what fuels they use is not Washington but Sacramento. Congress's 1990 Clean Air Act allows states to choose either the federal government's engine-emission requirements or California's tougher standards. Last week, nine East Coast governors and the mayor of the District of Columbia opted for the California plan. If their smog-fighting agreement holds, 1 of every 3 American motorists will be subject to more rigorous automobile inspections, cleaner-burning gasoline and rules requiring updated antipollution equipment on new cars bought late in this decade.

TAL McBRIDE–FOLIO



A smoggy day. *Washington, D.C.*

The pact also significantly increases the chances that electric cars will catch on. Within eight years, according to the California plan, 2 percent of new vehicles must be battery powered. Twelve years from now, 1 in 10 cars is to run on electricity.

DOWN TO EARTH FOR MASTERS OF THE UNIVERSE

Salomon Inc. is trying to get it together. An early sign of success is the way the scandal-scarred Wall Street firm's shares jumped last week in response to ads that trumpeted surprising earnings and more modest compensation for traders. Instead of paying huge bonuses to employees, Salomon's interim chairman, Warren Buffett, redirected $110 million to shareholders. The move has left analysts wondering whether other Wall Street firms will adopt a similar discretion. Meanwhile, the Salomon scandal has already prompted a big change. This week's Treasury auction will be the first in which the government uses new rules to prevent the kind of manipulation that, last summer, Salomon admitted it had practiced. Rather than restricting bidding to 39 primary dealers, the Treasury is allowing any registered broker to purchase its debt. This shouldn't raise Washington's borrowing costs, but it could further erode Salomon's position in the bond market.

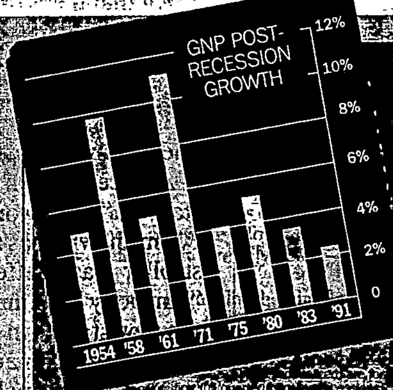
MONEY CLIP

RECOVERY STUCK ON THE ON RAMP

■ GNP growth, after three quarterly declines, suggests the economy is revving its engine. But other factors show it still spinning its wheels: September unemployment inched up to 6.8%, and consumer confidence plunged 17% to the lowest level since February.

■ Chances for tax relief receded as the budget deficit hit a new record—$269 billion. A lower-middle-income family today already pays less in federal payroll taxes—17.7%—than in the 1982 slump, when it paid 18.8%.

■ A drop in inflation to 2.1% enabled the Fed to shave interest rates amid hopes this would boost new-home sales critical to a recovery; in September, sales fell 12.9%, the biggest drop since 1989.



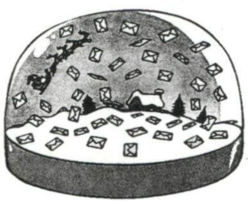
The current increase in GNP shows the weakest recovery from recession in 37 years and reinforces talk of double dip.

CALENDAR

Gun for sale ▪ On December 26, the revolver used by Jack Ruby to kill Lee Harvey Oswald will be auctioned in New York City. Earl Ruby, executor of his brother's estate, is asking that the bidding start at $100,000.

Gotta travel on ▪ On December 31, George Bush begins an 11-day tour of Australia, Singapore, South Korea and Japan. This is the same trip that the president canceled last month while under fire for ignoring domestic issues.

Season's greetings ▪ December 19 is the last day Christmas-card senders can mail their domestic-bound greetings and be assured of a timely delivery. Post offices may get a break this season. Greeting-card analysts believe sales are down slightly.



DATABASE

Average number of Christmas cards received per household last year: **26**

Decrease in big companies sending Christmas cards this year: **25%**

Hallmark Cards' designs for Christmas: **3,400**; for Hanuka: **125**

Share of Christmas cards bought by women: **90%**

Busiest mail day of the year: **Monday before Christmas week (234 million pieces on average)**

Average weight of a mail carrier's bag: **35 pounds**. Carriers who quit last December: **0.2%**

Postal employees in Alaska given "official Santa designee" status and allowed to open Santa's mail: **100**

Greeting cards sent by President Bush in 1990: **150,000, paid for by the Republican National Committee**

Mail sent this year by presidential mutt Millie: **3,041**. Letter carriers bitten by dogs in 1990: **2,700**

U.S. NEWS

JOBS: AWAY THEY FLEW

Forget the Christmas ham. The December gift that many American workers are receiving is a pink slip. General Motors this week is revealing details of a "major action"—most likely the closing of factories plus a speedup of an earlier plan to eliminate 20,000 jobs by 1993. Caterpillar last week announced the "probable closing" of its York, Pa., factory and the likely loss of 1,900 jobs. Xerox disclosed the layoff of 2,500 workers. TRW Inc., the big supplier of parts to the automotive and aerospace industries, announced a restructuring that will get rid of 10,000 positions. And IBM Chairman John Akers hinted that Big Blue might have to cut more than the 20,000 jobs it already plans to eliminate next year (story, Page 48).

In the '70s and '80s, blue-collar jobs faded. Now, white-collar slots are on the wane. Many losses are permanent, as high-tech jobs move overseas and defense contractors adjust to the post-cold-war world. Nor are cuts confined to the private sector. Thousands of state-government workers have been laid off, while huge numbers of teachers and local-government employees are sustaining pay freezes and furloughs. And although the official unemployment rate still hovers just below 7 percent, that figure does not account for 1 million people too discouraged to look for work.

One result: Seven of 10 voters in a *Wall Street Journal*/NBC News poll don't like the way George Bush is tending the economy. Many who have jobs are afraid they're going to lose them. That fear, in turn, is causing people to hold on to their money, which means an even slower economy and more layoffs. Many of the announced layoffs and plant closings will occur in mid-1992, just about the time the president tries to convince voters he has something going for him besides a victory overseas.

HEALTH WOES OF THE FUTURE

A half century ago, a government-run national health-care program seemed like something sure to come. But after World War II, a system that most Americans considered far better evolved: Companies began giving employees fully paid health insurance plans as a fringe benefit. Last week, a report by Families USA, an advocacy group for the poor and aged, suggested that the system that has served much of America for four decades is coming apart. "American families and American businesses are being priced out of health insurance," the organization concluded. In 1980, it said, 24.5 million Americans had no insurance. In 1990, some 34 million had none. In addition, wages are depressed because employers have been forced to spend more on health care. As a result, the average family this year is paying $4,296—nearly 12 percent of average family income—for health care. By the end of the decade, that bite is expected to top 16 percent. Employers also will suffer. The study predicts their health-care costs will quadruple by 2000. That, the study suggests, means wages at the start of the 21st century will be even more depressed.

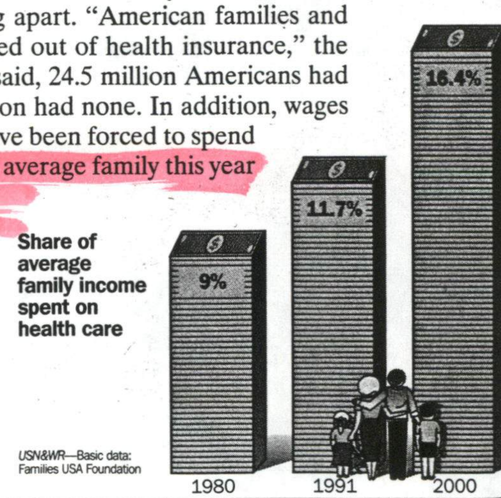


ILLUSTRATION: ISTVAN BANYAI FOR *USN&WR*; CARTOON: ROGERS—*PITTSBURGH PRESS*/UNITED FEATURE SYNDICATE