

—

Chron

8

5128198

Send to Burkhardt?

Yes ☒

no ☐

coordinate w/USG

Yes ☐

no ☐

May 21, 1998

President William Jefferson Clinton
The White House
Washington, D.C. 20500

Re: Guangzhou International Airport – The American Team

Dear Mr. President:

As you prepare for your historic journey to Beijing in June, we write to bring to your attention a strategic American commercial opportunity in China.

URS Corporation of San Francisco and Parsons Corporation of Pasadena have joined forces as the American Team bidding for the Phase I design contract award at the new international airport in Guangzhou. Phase I of the Guangzhou airport is a \$1 billion initiative by the Chinese. Winning the design contract is the key first step to assuring American involvement throughout the entire airport construction process. We believe also that the Guangzhou airport project is the largest environmentally clean infrastructure project open to American firms in China today.

The airport design competition at Guangzhou organized quickly along national lines and included a French team, a Dutch/British team, and a Canadian team, in addition to the URS/Parsons team. Currently, we believe the competition has narrowed to the American and French teams.

Although the United States is a recognized world leader in air transportation technology, URS and Parsons do not expect to win the Guangzhou design contract without the strong advocacy of the American government. *In fact, we were informed recently by members of the Airport Authority in Guangzhou that statements supportive of the American Team by you, Mr. President, would be extraordinarily helpful.*

The award of the Guangzhou airport design contract to the American team would be a watershed event in Asia for the American air transportation sector. Phase II of the project will require also approximately \$500 million of offshore equipment for the terminal, utility plants and air navigation systems. The winner of the design contract will have a clear opportunity to influence the equipment procurement process. To this end, Parsons has formed a consortium of U.S. equipment manufacturers who can supply the required equipment. We also have Export-Import

President William Jefferson Clinton
May 20, 1998
Page 2

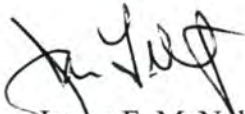
Bank letters of interest to arrange loans for the \$500 million of equipment. Parsons would manage the procurement and systems integration of the equipment contract.

Large Chinese infrastructure projects are especially significant given not only the uncertain impact of the Asian economic crisis on American exports, but also the growing trade deficit with China generally. As you know, when both services and goods are included, our recorded deficit with China exceeds our deficit with Japan.

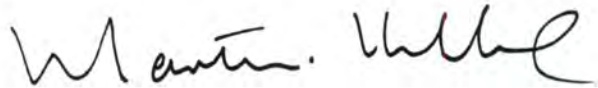
Your Administration, particularly Ambassador Sasser, has been very supportive of this project to date. We have together met personally with officials at the White House, the Commerce Department, the Transportation Department, and the State Department, including Ambassador Sasser, to discuss the design contract award process. In addition, we together spoke by telephone with Undersecretary of Commerce Aaron prior to his April trip to China, and a senior representative of the American Team accompanied Mr. Aaron on that trade mission. In each meeting and conversation, we have been assured that the Administration will take every opportunity to press the American Team's case with the Chinese government. With your visit now imminent, nothing would impress the Chinese more than your own personal involvement on behalf of two leading California infrastructure companies and their 15,000 employees.

Your June trip to Beijing represents an historic opportunity for enhanced peace and prosperity for both the American and Chinese peoples. We wish you well.

Sincerely,



James F. McNulty
Chairman and Chief Executive Officer
Parsons Corporation
Pasadena, California



Martin M. Koffel
Chairman and Chief Executive Officer
URS Corporation
San Francisco, California

cc: ✓ Vice President Albert Gore, Jr.
White House Chief of Staff Erskine Bowles
Secretary of State Madeleine Albright
Secretary of Commerce William Daley
Secretary of Transportation Rodney Slater
Ambassador James R. Sasser
National Security Adviser Sandy Berger
National Economic Advisor Gene Sperling

THE WHITE HOUSE
WASHINGTON

Date 5/28

To: Chuck Relf

From: The Staff Secretary

This is from a friend
of the President's (Georgetown '68)

How do you suggest we answer
the President's question of "what's
the deal here?"

Phil

Michael F. Conners encloses his letter to the U.S. Small Business Administration in which he resigns from the National Advisory Council in protest of the shabby treatment of Carl Burhanan, former White House Helicopter Commander.

Sub Sec

*What's the
deal now?*

'98 MAY 28 AM9:15

CORPORATE HEADQUARTERS
1645 Prince Street
Alexandria, VA 22314-2818
1-800-AIRSHIP
Fax: 703-683-9806
e-mail: airshipresources@prodigy.net

CORPORATE SALES OFFICE
15626 E. Sunburst Drive
Four
1-80
Fax:

AIRSHIP RESOURCES CORP

Aida Alvarez, Administrator
U.S. Small Business Administration
Washington, D.C. 20416

Re: Mishandling of Carl Burhan
Oasis Aviation, Inc.

Dear Administrator Alavarez:

This is to convey my resignation as a Member of the National Advisory Council of the Small Business Administration in protest of the shabby treatment of this great American and former White House Helicopter Commander by the bureaucrats at the SBA. I have known Carl Burhanan for over 25 years and I have corporate lending experience with a number of major U.S. banks, including Bankers Trust. Your people, hard working as they are, obviously do not understand the aviation fueling business in terms of its structure and financing.

For the record, Mr. Burhanan, although aware of my activities on behalf of your and the President's great agenda for the SBA, did not apprise me of the fact that he was applying for 8(a) status prior to his receiving what I consider to be a prejudiced response. Had he asked me, I would have advised what I know of this program, namely that his company might be too big for the mission of the program, but that, within the aviation fuel industry, he might well go ahead and apply, since within that business, his company is very small by comparison.

When he received his initial notification, he sent a well-researched response which was summarily dismissed by the SBA reviewer. That's when he apprised me of the situation and I suggested that he write you, since you are one of the hardest working top Administration officials and well you should be - the SBA is the "instrument of expansion" as my former Georgetown Professor, Carroll Quigley would put it, of our Nation's economy. Although it is obvious to me that his letter never reached you personally, the response, not from you, but another bureaucrat, simply disgusts me, hence my resignation.

Sincerely,

Michael F. Conners
Michael F. Conners
Vice Chairman

6/4 '68

cc: President Bill Clinton ✓

Mr. President:
This is, in the grand scheme of things, perhaps a minor item. Bill, on the hand it is an injustice.
Best,
Mike Conners
6/4 '68

Carl Buchanan





May 13, 1998

Mr. Richard L. Hayes
Associate Deputy Administrator
for Government Contract and
Minority Enterprise Development
U.S. Small Business Administration
Washington, DC 20416

Dear Mr. Hayes:

Thank you for your letter, dated 30 April 1998, concerning our 8(a) Application. I was disappointed that the Administrator didn't respond, but I'm getting to value any response from the SBA.

Again, I want to clarify the confusion all of you seem to have over our financial condition and character.

No, I don't have available credit of \$600,000 from the Bank of New York ("BNY"), as you have indicated. If you will look on Line 9 of the BNY Transaction Report 5-2-11, you will see that we have \$3,046,447 **available** credit. The \$630,097 on Line 10 is **excess** working capital.

Yes, we have total liabilities of \$7,618,804 but for every penny of debt we have **liquid** or **hard** assets to offset the debt. This does not include any value for our business which, BNY has appraised at a minimum value of \$21,000,000. Your question of solvency is totally unfounded.

The losses we have had are primarily related to debts assumed when I purchased this company. We assumed \$1,000,000 in tax debt, which is now paid off. These losses as a percentage of our total revenue are almost infinitesimal. You would be hard pressed to find any 8(a) company with a banking relationship better than mine.

My Corporate Counsel is a young lady, just a few years out of law school. She spent hundred's of hours preparing this application and was in continuous communication with your San Francisco office. She doesn't even know how to lie; so any mistake in the application is an honest mistake and has no bearing on the character of our company or anyone in the company.

Mr. Richard L. Hayes
Associate Deputy Administrator
for Government Contract and
Minority Enterprise Development
U.S. Small Business Administration
May 13, 1998
Page 2

Yes, the wrongful termination case was decided in favor of the employee. This doesn't mean that we did anything wrong, only that the Labor Board ruled in favor of the employee. This is a dilemma for all employers of large or small companies.

No, there was never a finding of any **illegal** oil spill and our firm has reported any and all fuel spills throughout the entire history of our company, which is now over twenty years. The fines imposed by the TNRCC were primarily for not doing many things their way and not necessarily the wrong way.

NASA, the military and the airlines are our major customers. We conduct our operations to suit our customers. NASA has the most rigid quality control procedures in the world. We pass NASA, the military and the airlines inspections, without any discrepancies. Yet, our procedures were not acceptable to the TNRCC.

Again, the DESC thinks we are the best contractor in their worldwide system (Ms. Irma Read 703-767-8481). Federal Express places great value on Oasis as a supplier and advisor (Mr. Chris Bolen). Our suppliers treasure our relationship (Mr. John Chapman, TOSCO 602-200-4196), (Mr. Jeff Beers, Shell 713-241-5262), (Mr. Mark Haynes, Avfuel 800-351-1393), and our bank, one of the best financial institutions, in this country, is eager for us to expand our business (Mr. James Belanger, BNY 213-930-3618).

These are not my opinions but the opinions of some of the top companies in the world. Yet, we are not good enough for your 8(a) program. Don't you think that maybe something is wrong with your program?

Sincerely



Carl Burhanan
President

Cc: Aida Alvarez, Administrator
Michael Conners

CB:tm

CB-RICHARD L. HAYES - SBA

Wetzel Elementary School
Unit 23815
APO AE 09034
May, 1998

Dear President Clinton,

I have taught for tl
very concerned by
power at the local

The essence of lea
and the erosion of
students of the mil
are simply stretche

Many people, educ
by DoDEA in Wa
explain the staffing
schools has levelec
had to eliminate su
teachers, behavior management positions, counselors, art, music, physical education and
classroom teachers.

The DoDDS schools are failing to provide adequate resources with which to educate the
students. Until the proper staffing is allocated and teachers are empowered to make
decisions, the quality of life for the military child will continue to decline. Students
living overseas depend solely on the schools to meet their educational and special needs.
They do not have the luxury of finding reading centers and music lessons in the
community or on the economy. These services must be provided by the schools if the
students are to succeed.

Please read through the following "Letters to the Editor" which have been published in
the European Stars and Stripes. I trust you will notice a pattern which supports my
concerns. Congress and the General Accounting Office must investigate and intervene on
behalf of the students. This trend of shortchanging the students must stop!

Thank you for your interest in the education of the children of the military personnel.

Sincerely,

Dorrie Meckes

Dorrie Meckes, first grade teacher and president of the Baumholder Area Education
Association

5/28/98
Came in interoffice mail -
Send to Burkhardt?
Yes _____
No _____

Get priorities straight

I am writing in hopes that the issues discussed may be addressed by Dr. Lillian Gonzalez, superintendent of schools for Department of Defense Education Activity, when she attends the ECAPTS conference in Chiemsee, Germany, this month. It is a source of frustration when policies and personnel changes are made by people in Washington who have little or no knowledge of the lifestyles led by military families in Europe.

Since Dr. Gonzalez has decided to enjoy the scenic benefits of a Bavarian holiday, it seems appropriate that she also take this time to answer some questions from the families upon whom her policies are having a negative impact.

First, the issue of moving principals every five years. It seems that in an organization that is short minimal essential operating funds, it would be wise to keep personnel moves to an absolute minimum, especially when the personnel in question have no desire to move, the faculty they support do not want them to move and the community is more than pleased with the quality of their performances.

I am speaking specifically of Richard Sagerman, who for the second consecutive year is facing a move that is not being supported by the Grafenwöhr, Germany, community or the teachers at Grafenwöhr Elementary School. Would it not be more advantageous to our children to take the money that would be used to move principals to hire additional classroom teachers or specialists to work in the schools?

What is Dr. Gonzalez doing to keep the student-teacher ratio from getting higher? DODEA uses an interesting method to determine the student-teacher ratio. It takes the number of students and divides it by all the educators in the building. So, although my daughter's first-grade class has 25 students, DODEA would report that our student-teacher ratio is 18.5 and is "going even lower." This measurement is not only inaccurate, it is also misleading. With numbers this high, it is impossible for the classroom teachers to provide remedial or enrichment activities for eligible students.

Is Dr. Gonzalez going to provide staffing for the schools to allow for the return of support personnel to provide remedial programs for the students? Currently, there are students who are eligible for and who would be receiving Chapter One services if they were attending schools in the United States; however, since our elementary school does not have a Chapter One teacher now and will not have a reading improvement specialist next year, these children are not receiving the help they deserve and need.

How can Dr. Gonzalez justify the increase of administrative personnel in Washington when the number of classroom teachers is declining? This has been a trend in DODEA since the beginning of the drawdown of military personnel in Europe.

How can Dr. Gonzalez and President Clinton say they are going to use DODEA as an example of excellence when the education the students are receiving meets the minimum requirements at best? Dr. Gonzalez and Clinton can do a lot of lip service to "excellence in education," but until funds are provided to allow for additional classroom teachers, "excellence in education" will be only something we read about in the newspa-

per. That is, assuming our students will actually be able to read.

I am pleased with the atmosphere of caring and concern that Grafenwöhr Elementary School demonstrates. It truly has the climate of a neighborhood school. Mr. Sagerman does the best he can with the resources and staffing available to him. He is fortunate to have supportive parents who volunteer in the classrooms and is additionally fortunate that many of these parents are former teachers.

But if Washington continues to undermine the progress that these "neighborhood schools" are trying to achieve, DODEA will be spending more and more money looking for solutions that only exist through channeling dollars and energies in the appropriate directions.

It is sad that the families that are already sacrificing much to defend our country are forced to sacrifice their children's education in the process. What does that say for the priorities of our administration in Washington?

Lisa C. Waugh
Grafenwöhr, Germany

Parents are key

I would like to congratulate the writer of "Dissatisfied with DODDS" (May 4) for recognizing in his daughter's first year of school the importance of family involvement in his child's success.

In his letter he suggested that the system was at fault for providing an unchallenging program for his daughter. He recounted how he had to become involved in his child's learning in math, social studies and science and that she is now reading at a fourth-grade level.

I feel he is to be commended for taking the initiative to be an active parent in his child's education and to be able to measure such remarkable progress. It isn't a matter of what the system is doing wrong, but an excellent example of what he is doing right.

This is what education is about, and this is what parents must do. I am a teacher, but I also know that I am not a child's only teacher. I am a partner in the success of our kids in a very complex and demanding world, not the ultimate resource. I know that I cannot guarantee the high-level performance of every child

if I have parents who do not take an active interest in what their children are doing, who do not assure that their children attend school regularly, who do not continue the educational process at home and who feel that it is my responsibility to keep their children occupied at night with hours of homework.

Our system and its educators have been shouting this message for years, and the writer's testimony is the best kind in support of what our schools and involved parents can do for our kids.

It is my hope that his family will continue the partnership with his daughter's schools for the next 11 years of her career and that his family will enjoy and share in her many successes.

Susan Krummrei
Wiesbaden, Germany

LETTERS TO T

DODDS, clean up mess

Well, I guess it was too much to hope for. In the past few months, I've seen articles in The Stars and Stripes that were making me think that Dr. Lillian Gonzalez and her mismanagement of the Department of Defense Dependents Schools/Department of Defense Education Activity system were finally going to be exposed. The Stars and Stripes seemed to be going after the problems and reporting on them, something that never used to happen in the old days of managed news. But in the past few days, I find that our newspaper once again has fallen for the DODDS propaganda machine. I must admit I am disappointed and highly disillusioned.

First, I read an article that leads with "Teachers to get pay raises" (May 8) that strongly hints the decision to raise salaries was in the face of other budget cuts in the system. Get real, and get the facts. DODDS teachers' salaries are set by Congress — based on the average of specific districts in the United States. DODDS neither decided to give a raise nor had any choice in the matter.

Second, I read the wonderful interview, "School system to 'maintain course'" (May 12) with Gonzalez where she shovels it so deep that I had difficulty keeping my hip waders clean. Since when, Dr. Gonzalez, did you ever ask your stakeholders — especially teachers — which programs worked, which were useful and which were a waste of time?

Talk about responses to austerity? Don't give us the party line about headquarters staffing. How can you possibly justify a system in which half of the employees are out of the classroom? Why do you wish to rotate principals? Not because it's good for the educational program, but because it helps you keep your power base — keep 'em moving and they can't react to your mismanagement. The School Improvement Process program is a great success. Ask the teachers and the administrators, and listen to their answers if you really want to know what your paperwork exercise is accomplishing within schools.

The most depressing thing about the interview, and the coverage of DODDS, was Dr. Gonzalez's final statement — that she intends to stay with DODDS for the foreseeable future. Please, you've done enough damage. Let someone else come in to clean up your mess.

Elda White
Bad Kreuznach, Germany

DODDS meeting raises concerns

By STEFAN ALFORD
Staff writer

CHIEMSEE, Germany – The white-capped swells on this resort-area lake often pick up speed behind gusting winds. The momentum is impressive, but in the end the resilient waves are knocked back by the high artificial stone barrier at the foot of the Armed Forces Recreation Center Lakeside Hotel.

Like nature's cyclical display, some of the enthusiasm and resolve generated by delegates attending the 40th annual European Congress of American Parents, Teachers and Students in Chiemsee last week was dampened by the reality of the obstacles ahead.

The cresting concern: three consecutive years of staffing cuts at Department of Defense Dependents Schools in Europe.

The proverbial brick wall: a combination of budgetary constraints, decreasing student populations and, in the eyes of some educators, a lack of higher headquarters support.

A representative of the Department of Defense Education Activity, the DODDS parent organization in Arlington, Va., touched on the issue at the May 11-15 conference, which drew more than 100 members from 37 DODDS-Europe schools.

Jerald Bloom, chief of educational support, policy and legislation, acknowledged that the education activity is aware of the growing community concern surrounding continuing teacher reductions in elementary schools, but that it's "a question of money and resources," neither of which is sufficient. Bloom attended in the place of the education activity's director, Lillian Gonzalez.

Bloom said the European PTSA's concerns are "looked upon with a great deal of seriousness" and the group's voice is a factor in the activity's decision-making processes.

As an example, the activity implemented a new middle

school staffing model and adopted several recommendations of the 1996 Staffing Task Force Study that will increase the number of teachers and support staff for the 1998-99 school year, said Jim Jarrard, of the activity's communications office.

The middle school initiative will bring 35 new positions to Europe, and the task force study also will add more than 20 total staff members in the areas of education technologists, information specialists in media centers, guidance counselors and school nurses.

These additions will increase DODDS-Europe teaching positions next year by 45 instructors – even though smaller elementary schools are losing specialized educators in areas like art and music.

The activity's staffing level of classroom teachers will increase from 2,665.5 for the 1997-98 school year to a projected 2,711 teachers for the 1998-99 school year, according to the Arlington office.

Also in Chiemsee, the PTSA reaffirmed a holdover resolution from 1995 – the introduction of program-based staffing as opposed to guidelines based on staffing ratios.

This proposal would allow for retention of art teachers, counselors, school nurses and other special-needs instructors at schools that are losing those positions because of small enrollment sizes.

The delegates also passed two new resolutions in hopes that the education activity will focus more attention on program-based staffing:

- One resolution calls for DODDS to change the existing art teacher-student ratio from 1 to 750 to 1 to 500 and to offer instruction by certified art teachers at all elementary schools, regardless of size.

- The other aims to reduce the counselor-student ratio from 1 to 600 at the elementary level and 1 to 450 at the secondary level to 1 to 300 for both, bringing the military

school system's counseling program in line with recommended national standards.

Some other major players in education are adding their support as well.

National PTA President Lois Jean White, a guest speaker at the conference, stressed the need for adequate counselors in a military environment.

"School counselors are probably needed more here than in the States because of the different family stresses caused by unique military disruptions," such as frequent moves and temporary deployments of the military member, White said.

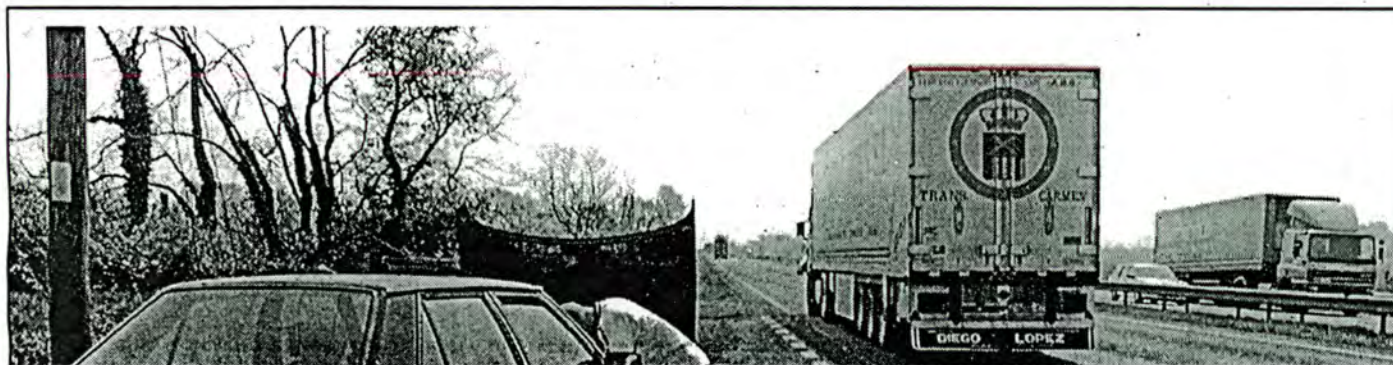
The European education committee chairman of the National Association for the Advancement of Colored People also stressed the need for program-based staffing.

"We completely support the idea that staffing should be based on programs, not the number of kids," said NAACP representative Willard Hall. "We'll put our voice behind this issue because kids in smaller communities are being punished by this."

In response to such criticism, Jarrard said that while elementary school staffing is still driven by enrollment, "there is some experimentation beyond the strictly enrollment-based system, as shown by our middle school program. We're seeing some movement toward that area (program-based staffing), but we have to be careful to stay within our allowed (staffing budget) as given by the Department of Defense comptroller."

Gonzalez, in a statement last week, said, "I will continue to actively pursue elimination of obsolete or redundant programs, implement program efficiencies and reprogram resources that are released to further support educational initiatives."

Still, those attending the conference said they believe change will come slowly.



Protesters hold quiet rally outside Japan bases

BY DAVID ALLEN
Pacific Stars and Stripes

Parents' opinions matter

I am a parent who is very interested in supporting the schools my children attend, so when I was asked to be the president of the School Advisory Committee (SAC), I jumped at the chance. I soon learned that this was no opportunity at all. It's like so many of the Department of Defense Dependents Schools organizations. A lot of time is spent at meetings, but nothing is ever accomplished. SAC has no power at all. It can only advise the principal. Then, he makes the final decision.

I get frustrated when I am asked why parents will no longer come to our SAC meetings. The truth is, they are frustrated, too.

We have no reading lab or math lab, and many of our classes are too large. We share specialists with another school. Another concern is the staffing of qualified people for our children. We have been trying for years to point out our problems to administration at all levels but have just been ignored.

**Claudia Fraijo
Baumholder, Germany**

Listen to teachers, parents

The best way to solve the problem of the "targeted schools" is to listen to the teachers and parents. They have been asking for, almost pleading for, more classroom teachers, smaller class sizes and specialists to teach reading and remedial education.

So what does the Department of Defense Dependents Schools do in its infinite wisdom? Hire another bureaucrat and give her the fancy title of Home-Schooling Partnership Coordinator. Another waste of time and money. A brainstorm of another bureaucrat who received a monetary award for her "new" idea. A total waste of your and my tax dollars. We don't have enough money to hire lunchroom monitors next year.

We already have a home-school partnership in our schools, and it is called The Parents, Teachers and Students Association - PTSA. Let's use it. Parents and teachers can help solve the problems of the deficient schools. DODDS should listen to the suggestions of the teachers and parents.

**Maria Turner
Baumholder, Germany**

Children are the losers

I was shocked to read the story regarding the almost \$32 million in penalties imposed against Department of Defense Dependents Schools for not using funded positions and not paying their bills.

As someone who has worked with the schools for several years, I know that some schools have one music teacher or counselor for 900 children, and psychologists and speech therapists are "itinerant" and travel to as many as five different schools per week.

School administrators have to practically beg DODDS headquarters for additional positions to relieve crowded classrooms or to get an additional aide for a child with special needs. Not only did DODDS headquarters not fill funded positions, but to add insult to injury, now they have lost \$31.9 million from their operating budget.

There is one group of losers in this scandal: the children attending the schools.

There is a great deal of talk these days about so-called quality of life issues in the military. Parents need to sit up and take notice that "quality" is not having Europe's biggest shopping mall or a 12-lane gas station. It means investing in the education and lives of our children by ensuring that the schools are properly staffed and their children's needs are being met.

**Brian J. Olden
Würzburg, Germany**

To the teachers be fair

I'm a student at Patch American High School in Vaihingen, Germany. Recently, I noticed that many teachers were wearing a sign that said, "We care for the children, so be fair to the teachers." The sign means that our school has been told to reduce the teaching staff by two teachers. The two teachers were both newly hired and selected from the English and history departments. One of the teachers is a ninth-grade history instructor. My brother thinks she was the best teacher he ever had. She was strict, controlled the class and made him enjoy history.

It does not make any sense to lay off good teachers. If any reduction is necessary, then it should be done by quality, not by the number of years on the job. The DODDS school board needs to re-evaluate its criteria for reducing the teaching staff during the very difficult military and civilian downsizing. The children at Patch High School care, too. If you walk through the halls of Patch, you'll find that nearly every child has a sign on that says, "To the teachers be fair. The students care."

Rethany DesLauriers

Don't move principals

Dr. Lillian Gonzalez, director of the Department of Defense Education Activity, has decided to reassign principals who have been at their respective schools for more than seven years. The reason? None. Except that she has decided, on her own, to implement a new policy.

Having already decimated staffing at the school level, mysteriously identified schools with low test scores, eliminated most summer training workshops and limited the teacher transfer program, she has now decided to move successful principals, even though the "stakeholders" (parents, teachers and commanders) have asked that their respective principals remain.

As a parent of two children attending Ansbach Elementary School in Germany and as president of the School Advisory Committee, I take issue with Dr. Gonzalez's directive to reassign our principal. Ansbach Elementary School is a place where children are learning, morale is high, test scores are excellent and the community supports the school, teachers, and principal. In other words, it's as good as it gets.

Yet, Dr. Gonzalez wants to change all this by moving the principal. In her own words, she says: "In effecting reassignments of principals, a number of factors are considered. These include qualifications and preferences of the principal, input from the community and stakeholders, and recommendations of district superintendents and other DODDS officials." The Ansbach Elementary School principal meets every aspect of this criteria. I know he prefers to remain. The input from the community asks that he remain, and I am positive the superintendent endorses the same.

Could not the money wasted to move our principal be better spent in restoring the remedial reading slot cut by Dr. Gonzalez? How about lowering class size? Can we not get a counselor for more than two days a week? How about making our itinerant art, music and physical education specialists full time? What's wrong with having a full-time nurse? Is that so impossible?

Yet all these requests and pleas fall on deaf ears.

As parents, have we no input into the education of our children and our school? Apparently not. What's next? Remove textbooks?

Katherine Riggins
Ansbach, Germany

DODDS should think first

In response to "To the teachers be fair" (March 31) about downsizing, the writer is absolutely correct. It does not make any sense to lay off good teachers and to keep the dead weight ones. If reduction is necessary, then yes, it should be done by quality not seniority. The Department of Defense Dependents Schools system does need to re-evaluate its criteria for reducing the teaching staff.

This situation is happening at my children's school (Vajont Elementary). One of the best second grade teachers is being let go. I've had two children in her class who think she is the best. My family and I are deeply disappointed.

Come on, DODDS. Get with it and think before you act.

Kathy Anderson
Aviano, Italy

Why lock students out?

Many parents have expressed concern about Bamberg's school policy to lock the doors of the school during lunch. It has been brought to the attention of the base support battalion and to the school administration. The only answer we get is, "We don't want kids roaming the halls during lunch." I would suggest that roaming the halls during lunch is a much better alternative than what could be going on off school grounds.

Each day the administration turns 300 students loose into the community at lunch and then "locks" the doors. The children are allowed to go to the cafeteria, but once they enter, they must stay there. I believe this is to deter kids from eating in the lunch room.

I am curious to know who, for those 45 minutes each day, is responsible for my children? What are they doing during this time? Sure, there are kids who live on post who go home for lunch. Several go to Burger King; but what about those who are visiting soldiers in the barracks, or going up into the woods, or smoking out in front of the bowling alley?

Is Bamberg the only DODDS school in Europe with the policy of locking its students out?

Susan Desens
Bamberg, Germany

More on 'target' schools

As a teacher formerly assigned to one of the so-called "targeted" schools in Germany, I have followed the recent coverage in *The Stars and Stripes* with interest. I commend *The Stars and Stripes* for printing the teachers' point of view ("Teachers off plan to improve test scores," Feb. 26). However, two things disturb me which were not addressed in the article.

First, if I understand correctly, the selection of these targeted schools was based on the "old" version of the Comprehensive Test of Basic Skills (CTBS) standardized test. As of this school year, the old test will not be administered in the Department of Defense Dependents Schools any more, as it was determined that it was not aligned with the DODDS curriculum. Instead, DODDS will use the Terra Nova, a newer version of the CTBS, which is better aligned not only with the content of the DODDS curriculum, but also with the manner in which the students are expected to respond.

That is to say, not only item knowledge is expected. There are open-ended questions that give the students the opportunity to demonstrate higher levels of understanding than just rote memorization of item knowledge, or comprehension of what they have read.

According to University of Chicago professor Benjamin S. Bloom, knowledge is the lowest level of understanding. Questions testing knowledge elicit factual answers, test recall and recognition. Bloom places comprehension next, followed by application, analysis, evaluation and synthesis. DODDS students are challenged to expand their thinking to these more complex levels, and the Terra Nova does a better job of measuring this.

Last school year, the Terra Nova was administered to DODDS fourth-graders as a trial. The students did well on this test in the targeted school where I was teaching. However, this was not considered in the selection process for "targeted schools."

My second concern is about the pupil/teacher ratio. The article did not state how this ratio is calculated by DODDS. If I'm correct, DODDS figures not only the classroom teachers, but all the specialists as well, in computing this ratio. The DODDS PTRs quoted would lead one to believe that classroom sizes are already small. When the teachers said class size should be reduced to 18 for grades 1 through 3, they meant 18 children to one classroom teacher. Knowing the current DODDS PTR for a school does not mean you know the actual class sizes.

Susan Gallant
Keflavik, Iceland

Process not Patchwork

The purpose of this letter is to advise readers of the faculty downsizing effort at Patch American High School, Stuttgart, Germany, and the lack of proper information pertaining to the selection criteria for this effort.

The lack of information pertaining to the guidelines and rationale for this downsizing effort gives the distinct impression that it is being conducted in an arbitrary and capricious manner, with a predetermined outcome that is not in keeping with the Department of Defense Dependents Schools policy.

Most of us are aware that downsizing is a fact of life and that it is impossible to make everyone happy in such an unfortunate situation. Therefore, every effort should be made to ensure that downsizing activities are accomplished in a totally fair and impartial manner while strictly adhering to the pertinent DODDS policies and guidance. There should be no ambiguity or distortion of the rational used to select individuals to be declared excess.

Being a former resident of Patch Barracks and a parent of children attending DODDS, I am keenly aware of the need to ensure that DODDS provides the very best that can be offered. This includes not only providing quality faculty and administrators, but ensuring that all personnel matters are properly conducted.

If you were told that you were losing

your job, I believe you would want to know why. In this case, the outpouring of support from parents, teachers and students indicates there is something very wrong with the process at Patch. A tenured teacher of 10 years in DODDS has been declared excess, and a new teacher with only two months in DODDS has been retained. Why? Is this situation the result of a hidden plan gone awry? Are any teachers safe from the process used to target selected, tenured teachers?

Unfortunately, it is the children who will ultimately suffer most from this situation. It appears the parents and students at Patch recognize the problem. The real question is whether DODDS officials will bury their heads in the sand or recognize and take appropriate action.

Lt. Col. James C. McCrory Jr. (Ret.)
Fairfax Station, Va.

Cuts hurting education

I have been a teacher at Bad Kreuznach Elementary School in Germany for five years and a teacher at Dexheim for one year. Since Lillian Gonzalez became superintendent for the Department of Defense Education Activity, I have seen many cuts made. These cuts are at the lowest levels, in the schools, where they directly affect our children. When I saw the budget cuts for this year in The Stars and Stripes, I knew where the cutbacks would come from: the bottom. And they did. This coming year at Bad Kreuznach Elementary School, 2.5 classroom teachers were cut. This affects first, second and third grades. With our current enrollment, this translates to those grade levels starting the school year with 30-plus children in each classroom. So much for President Clinton's request for smaller

class sizes. Presently, in grades one through six, we have an average of about 22 children per class.

In the past six years, Bad Kreuznach also has had its full-time reading specialist, compensatory-education teacher and English as a second language teachers eliminated. Last year, our music and art teachers were cut to part time, and this year our physical education teacher became part time. We also have had a full-time special education teacher cut.

Of all places, Bad Kreuznach desperately needs a compensatory-education teacher and a reading specialist. We have a large group of low-functioning and low-achieving students in this community who are in need of additional help to be successful in school. These are the children who are falling through the cracks because they don't qualify for special education. They eventually get to high school, can't read or write and drop out. Probably every classroom has two or three of these children. How do we even begin to individualize and help these children with 30-plus students in a class? The teachers at Bad Kreuznach have been begging for these slots ever since they were taken away, but to no avail.

I feel bad for the teachers and children at the designated framework schools whose national test scores fall below the norm. The blame seems to be pointing to "defective" teachers. I think we need to look at what support programs and teachers have been cut from these schools. There are some excellent teachers, and to blame teachers is very demoralizing to the entire faculties of these schools.

My hope is that people in the military can effect some changes by dealing directly with DODEA's upper echelon. After all, these are your children and our future.

Liz Harte
Bad Kreuznach, Germany

Distance classes earn F

Most students need calculus before they enter college, especially if they already know they want to go into science or engineering programs. At first we were very troubled because the only calculus class that was offered was by computer (distance-learning classes). For the DLCs, the "teacher" is at some other school. The students work on the "class" assignments at their computers while another teacher acts as a "facilitator" or, in other words, a person who keeps an eye on the student. They do not necessarily have any ability to assist the child in the assignments.

Former students told us horror stories of how they had no books for six to eight weeks. No assistance from teachers on how to correctly do problems, even though they were assured that a qualified teacher would only be a phone call or e-mail away. Computers regularly would have problems of one kind or another, making assignments late and adversely affecting a grade. Other problems arose because the hosting school was on a different schedule than our school. All of the stories we heard were first-hand accounts, which gave us strong doubts that this type of class would be beneficial for anyone.

School officials assured us that all of these problems would be solved. We registered in April (five months before class started). After six weeks of class, we found all the same problems and more were occurring. The students were told that the problems were all based on their deficiencies and that no other school had such problems. I got on the Internet to check on my child's class progress. Students Europe-wide, according to the grades posted, were having some challenges. The grades were: 31 percent: A; 6 percent: B; 7 percent: C; 11 percent: D; 42 percent: F.

We started calling parents, locally and in other school districts in Europe, only to find the same problems.

The Department of Defense Dependents Schools has been offering DLCs for several years now. The problems remain the same. We're told that our children get a great education here in Europe. For the most part, they do. When it comes to an education that will enable them to become doctors, engineers, etc., don't count on DODDS.

Many technical colleges in America won't even consider you unless you've taken advanced math or science. When I complained about the quality of high school courses recently, a general officer's wife told me, "That's the price we pay to have the privilege to work overseas."

If that's the case, then parents and students should be warned before they come overseas.

Kathy Smith
Büdingen, Germany

Get back to basics

The recent article in *The Stars and Stripes*, "Experts coming to debug DODDS" (Feb. 5), concerns and upsets me, especially because one of the schools mentioned is Wetzel Elementary in Baumholder, Germany, where I have taught for the past 10 years.

Many years ago, Wetzel teachers recognized the need for Wetzel to have smaller classes and more teachers. My colleagues and I, together with many parents, have made requests through the Parent, Teacher, Student Association, the School Advisory Committee, the district and regional offices and to the Department of Defense Dependents Schools in Washington, D.C., for additional teachers and specialists to ensure a proper education for our children.

We have asked for quality teacher training to educate teachers on how to teach reading in grades kindergarten through three, the most important and fundamental part of learning. In fact, many of our teachers here at Wetzel returned from their holidays early in the summer of 1996 and brought in and paid for special training from a noted California reading expert to try to improve their own teaching skills.

Did DODDS get the message? No. On the contrary, we have lost specialists in compensatory education and reading improvement, and we share specialists in English as a second language, art, physical education, music, host nation and media with another school.

DODDS just doesn't get it.

Now, after years of mismanagement and the loss of \$30 million in funding, DODDS will spend more tax dollars (dollars that could be spent on more teachers) on so-called "experts" to come in and solve the problem.

More jobs created for more bureaucrats.

Wouldn't it be more cost-effective to have meaningful teacher training (particularly in the field of reading), hire more quality teachers and have smaller classes with more individual attention per student, all of which would result in better learning and better test scores?

Come on, DODDS, let's get back to the basics.

Dorothy Lundgren
Baumholder, Germany

Teachers need support

Amen to "Let teachers do jobs" (Oct. 19), concerning giving what is best to children. The writer is exactly correct in suggesting that "children need a structured, challenging environment in which to learn."

Unfortunately, teachers in the Department of Defense Education Activity are mandated by policy to promote all students from kindergarten through grade eight. Some have even been directed by their administrator to sign a report card.

Teachers' eyes are open. Many know what they are achieving. But until teachers are empowered to choose the textbooks, have a voice in decision making, and are respected as professionals, we will not be able to successfully educate the children.

In DODEA, if changes are to be made, they must be made at the top. For it is the directors in Washington, not the teachers in the field, who make the decisions and dictate the programs being used in the schools.

If parents want to be heard, they need to contact the members of Congress and the Secretary of Defense. Give us the opportunity to do what we have been trained to do. We welcome the challenge.

Dorrie Meckes
Baumholder, Germany

Let teachers do jobs

Salute to the school district officer in Chicago who has the foresight and strength of commitment to adopt a no-pass-no-promotion system in his school district. The question now arises: When is DODDS going to adopt a similar system? Give the children what is best for them:

a structured, challenging environment in which they will want to learn and succeed. Don't continue passing children because it is the socially correct thing to do. This is no more than a quick fix; and those practicing it are no more than buck-passers.

Teachers should open their eyes and see what they are achieving. Start doing what they are paid to do: Educate the children. Give them challenges, give them a structured environment, give them a disciplined program, give them the rewards of success in education and show them the price of failing.

Teachers and school administrators will have to be held accountable for their successes and failures alike. Teachers will have to concentrate fully on educating the children, and administrators will have to commit to working for the teachers, giving them the best of environments in which to do their jobs.

The Utopia described won't be hard to achieve if administrators and teachers simply work for the children in their charge and prepare them for the real world they will live in as adults.

Parents, be heard. Let your schools know you want education, not social promotion, for your children. Get the administrators to give the classroom back to the teachers. After all, it's only your child's future.

Beverley Haywood
Kaiserslautern, Germany

Please define offense

Because of the Department of Defense Dependents Schools policy instituted last year by Department of Defense Education Activity Superintendent Lillian Gonzalez, a teacher is "guilty" of "abuse" until the local Family Advocacy Program has time to investigate.

When a student fabricates a story against a teacher, the assumption that a teacher is guilty of child abuse until an investigation occurs is wrong, wrong, wrong. Something needs to be done to change this policy. I believe that every accusation of child abuse should be investigated, but not necessarily by the Family Advocacy Program. I also believe there is no need to place a teacher on administrative leave during the investigation if school officials have determined that there are no safety issues involved.

The DODDS professionals (administrators, nurses and counselors) should be the initial point of contact in investigating child abuse accusations against teachers. The students are suffering under this twisted rule that has removed this level of investigation and ultimately prolongs resolution. These professionals need to be

put back into the loop and allowed to make an initial assessment of which cases need to go forward to FAP.

The Federal Education Association asked Gonzalez to form a task force on "teacher touch" to define child abuse. This task force is necessary because there is so much confusion about what actually constitutes child abuse. Our teachers must have a working definition that they can understand.

Gonzalez has denied permission to even form this task force. What is she afraid of? Who would benefit? Students. Who suffers because we have no definition of child abuse? Students. Multiply the 400 students by the 60 unsubstantiated cases against teachers since the Gonzalez memo and you have 24,000 students per day not receiving the best education possible in DODDS.

The bottom line is: Teachers cannot "challenge" students to do their best with this constant threat of being suspended for false allegations of abuse. Come on, Gonzalez, give us some definitions.

Edward T. Carlin
Mannheim, Germany

COMMENTARY

DODDS no bargain

I have had three children in the Department of Defense Dependents Schools for the past four years. I have noticed without exception, that the more the progress through the grades, the less they seem to learn.

My seventh-grader came home with pre-algebra worksheet recently. The sheet was complete except for the last few questions. This was her homework. They are working with basic decimals now and were asked to convert certain numbers into decimals. This is a basic math function, not algebra, and she was unable to do this. I looked at the worksheet and noticed that all of the other problems were answered correctly. When asked how she could do 40 problems correctly and was unable to understand how to do the last five, she responded with, "Our teacher only showed us how to do this with a calculator."

Shouldn't DODDS be teaching our children how to work something out with a pencil and paper before allowing the use of electronic devices? I'm all for the

electronic age, but teach our children basic survival skills before introducing the technology of today.

After seeing what my daughter wasn't learning in school from the teacher, I took her books to look at them. They are a joke. The so-called pre-algebra book is the equivalent of about a fifth-grade math book (if even that complicated).

I read in the paper all the time about DODDS wanting more money and more teachers. Maybe what it should do is spend the money it does have on quality books and teachers. Twenty years ago DODDS was one of the best schools you could attend. Now I would rate it below the 50th percentile. You don't have to believe me, though, just look at the latest exam scores.

If DODDS schools are considered a benefit of being in the military, I think I'm being cheated. I know my children are.

Kevin Peter
Ramstein Air Base, Germany

This is for the unfortunate parent of the child with dyslexia who was getting no help from Department of Defense Dependents Schools. It is certainly very discouraging to read that DODDS cannot meet this child's needs. But parents in a situation like this don't have time to waste on being discouraged. There's a child who needs help, and that takes priority over everything.

I wonder if the letter writer has considered home-schooling? That was the answer for our special-needs daughter, who was miserable, experiencing failure and social rejection, and learning practically nothing in the DODDS school. Oh, sure,

there's the question of fairness.

Federal law says every child is entitled to an education to his or her special needs at public expense. But who's got time to waste arguing a fight you know you can't win?

Our daughter is thriving in home-schooling and is learning in keeping with her normal intelligence. I have little doubt that, had she stayed in DODDS, she would have moved from grade to grade illiterate. School professionals won't tell you about home-schooling because they don't want to admit that parents can do a better job than they can.

Check out the average test scores for home-schooled students — they put the scores of public schools to shame. The advantage of home-schooling is one-on-one tutoring and a program geared to that individual child taught by the people who know more (and care more) about that child than anyone else in the world — the parents. Special-needs children in particular benefit from this.

I'm glad I discovered home-schooling and my child is not at the mercy of DODDS.

Judy Gerling Clark
Lajes Field, Azores

LETTERS TO THE EDITOR

Voice your concerns

In reference to "Good DODDS experience" (April 17), I agree that the Department of Defense Dependents Schools is very good. The writer should not, however, gloss over problem areas based on her experience with only one DODDS school. There are legitimate problems that need to be addressed publicly, and the Letters to the Editor provides an excellent forum. The Stars and Stripes readers can distinguish between legitimate complaints and sour grapes whining.

One crucial topic at present is school staffing. DODDS schools are being staffed based on student population rather than the specific needs of the school and community. Regardless of the size of the school, our children need and deserve quality art, music and academic programs. Our children need and deserve to have necessary counseling and nursing services. Our children need and deserve a class size that permits teachers to teach and children to learn.

Parents have an opportunity to voice their concerns through the local Parent Teacher Association and the School Advisory Committee. Parents also have the opportunity to voice concerns through The Stars and Stripes. I, too, appreciate what DODDS has done and is doing for my children. I also applaud the parents

who become involved and speak out to make our school system more responsive to parent, student and community needs

Bob Forc
Ramstein Air Base, Germany

Young brains nourished by music, arts

Pittsburgh Post-Gazette

PITTSBURGH — Want to give the brain a good workout?

Try making music or doing art.

"Children not only enjoy the arts but learn a great deal from it," said Sarah Tambucci, principal of Chartiers Valley Intermediate School and past president of the National Art Education Association.

She thinks the arts can stimulate learning, help with memory and foster creative problem-solving.

Researchers are bolstering that argument, long made by arts educators, with

studies that link music training with math-related skills.

The theory of "multiple intelligences," was developed by Harvard University Professor Howard Gardner, whose book *Frames of Mind* was first published in 1983, and his research has been verified by other scientists.

Gardner says there are at least eight forms of intelligences, which people have in varying amounts: language, logic, musical, spatial, bodily, naturalist, interpersonal and intrapersonal.

"A good educational system ought to nourish and nurture the range of intelli-

gences, which include several featured in the arts. Otherwise, we will be neglecting important forms of human potential and stunting the cognitive development of youngsters," Gardner said.

"All youngsters everywhere should have exposure to the greatest creations of the human mind and spirit in our society," he said. "That would include painters like Rembrandt and Picasso, musicians like Mozart and Duke Ellington, writers like Shakespeare, George Eliot and Toni Morrison."

Ideally, Gardner said, students should be exposed to all art forms at all ages.

Yet these areas are being cut by DoDEA!

Teachers protest school jobs cuts

By CHUCK ROBERTS
Kaiserslautern bureau

BAD KREUZNACH, Germany — Local teachers gathered Wednesday at the post exchange to protest an upcoming reduction of six teachers in the Kaiserslautern school district.

The teachers said the cuts are based on what they claim is a flawed formula for determining future students levels.

"Next year is going to be chaos around here" because of crowded classes created by the formula, said Angel Hattenhauer, one of four teachers scheduled to be trimmed at Bad Kreuznach Elementary School.

The two other jobs will be cut at the Bad Kreuznach High School.

The reductions are based on a Department of Defense Dependents Schools forecast that predicts a 7.3 percent reduction in the student population for the next school year.

That prediction is based on the number of families being reassigned to and from local communities, said Terrence Kacik, superintendent for the Kaiserslautern school district.

Those numbers could change based on the number of students enrolled in the up-

coming spring registration for the next school year, Kacik said. However, he said historically the projected level of students varies only by about 1 percent. Based on those estimates, Bad Kreuznach would have 376 students.

But teachers claim that number was based on last spring's enrollment. They said a more accurate number is 420, which is the number of students currently enrolled at the elementary school.

Since the 1990 school year, Kacik said, the student population at the elementary school has dropped from 682 students to next year's projected 376.

The teachers handed out fliers explaining the number of teacher cuts and the possible effect, and also asked parents to sign prewritten letters to their congressional representatives and to the director of the Department of Defense Education Activity.

One mother taking home the forms was Bettina Rosamond, who said she thought teachers shouldn't face more cuts.

"If they cut it down any more they won't be able to do their job — it doesn't matter how hard they try," said Rosamond, who has a child in the fifth grade.

Hattenhauer, a second-grade teacher, said she knows she'll have a job next year



Roseann Drydale (left), a first-grade teacher at Bad Kreuznach Elementary School, Germany, talks to Charles Woods Sr. in front of the post exchange after handing out a flier about teacher cutbacks. Woods is with his daughter Courtney, 4, who is in school yet, but he has five other children going to school in Bad Kreuznach.

but doesn't know where.

It is the second year in a row for cuts at the elementary school. Last year, officials announced that one classroom slot was to be eliminated; that art music, physical education and counselor slots were to be reduced to part time; and that a psychologist

no longer was assigned to the school.

"This has been going on for several years now where we have to play the numbers game," said Roseann Drydale, a first-grade teacher and a faculty representative.

"The bottom line is it hurts the

DODDS educators protest

By AMEE SEABOLT
Washington bureau

ARLINGTON, Va. — About 30 leaders of a teachers union picketed early Tuesday outside the Department of Defense Education Activity to express their frustration with school policies.

"We wanted to do something to be sure we would be heard," Jan Mohr, president of the Federal Education Association, said as she toted her sign outside of the busy sidewalk of the headquarters.

"Teachers are frustrated for not being heard. We felt that by picketing we could bring attention not only to DODEA (the education activity) but to the public as well."

Mohr, key staff and board members passed out fliers to pedestrians and encouraged drivers to honk their horns as a sign of support. Union officials representing schools in Europe, the Pacific Rim and stateside installations participated in the protest, which began around 7 a.m.

Protesters carried signs that said such things as "the real experts are in the classroom" and "DODEA budget penalties hurt kids."

Those signs were directed at two problems that have shaken the schools recently:

- A decision to send in special experts to 16 schools where students' scores on basic skills tests are lagging. Six of those schools are in Germany.

- The denial of \$31.9 million in funding because of budget issues.

Mohr said it has been nearly 10 years since the union last held such a protest.

The director of the education activity was not pleased by the protest.

"While today's activity may have gotten some attention, it did nothing to help achieve DODEA's goal of success for all



S&S: Amee Seabolt

Jan Mohr, president of the Federal Education Association, leads about 20 top educators during a march Tuesday on the Department of Defense Education Activity headquarters in Arlington, Va.

our children," Lillian Gonzalez, director of the education activity, said in a statement.

Earlier, her spokeswoman said officials were concerned about consistent misunderstandings by teachers about their policy decisions.

Patricia Lambe acknowledged there may have been less involvement of teachers during the development stage of the school improvement plan. But Lambe said the involvement would increase as the plan is introduced.

"Some of the decisions were just man-

agement decisions," Lambe said. "We did not set out to craft a cookie-cutter program for the schools identified. We looked at schools that would be most likely to benefit and where we can make a difference the most."

Lambe also said the classroom may not be the only reason why the schools were selected for the program.

She said some things at the schools are working well while other things are not — at no fault to teachers, parents, students or the schools.

Teachers upset with DODDS

Don't feel part of plan to increase test scores

By MICHAEL MADDOX
Würzburg bureau

SCHWEINFURT, Germany — Teachers at Schweinfurt Middle School are upset about the way DODDS plans to correct shortfalls in test scores at six schools in Germany, including theirs.

The teachers expressed their animosity Wednesday after a meeting organized by administrators in the Department of Defense Dependents Schools to explain the plan.

"If the plan is there, we would like to be involved in it. We would like to have a say," said Karen Rose, a physical education teacher at the school and an officer with the Federal Educators Association. "I feel we are being told by people who are not in the classrooms and have no knowledge about our community. We don't feel they are the experts who need to be in on the plan. We need to be in on that plan."

The teachers also dislike the way the community was informed about the decision. Larry Gillis, a science teacher at the school, said he first learned about the program's details through a newspaper article in January.

"If we seem a little defensive about all of this, it's because we weren't treated like the professionals we are," Gillis said. "How am I expected to feel when the first information I get is in an article in a newspaper that's obviously, or at least on the surface, hostile? I haven't calmed down completely yet, but I'm going to do my job and I'll continue to do that."

Rose said the way the information was released has had a damaging effect.

"The information that has been given out through newspapers, whether it's good, bad or indifferent, that information and the headlines have hurt our relationship with the parents. We would like to amend that," Rose said.

E.B. Stafford, principal of Schweinfurt Middle School, acknowledged that few details of the program were available until January. But he said he did tell teachers in December that a plan was being drawn up.

"That's all that we knew at the time, no particulars, no nothing," Stafford said.



S&S: Michael Maddox

Richard Osner, superintendent of Würzburg area schools, tells Schweinfurt Middle School teachers about plans to raise students' test scores.

"Clarification only on how and when the plan would be implemented came around the time the article came out."

In response to the teachers' other criticism, an education activity official said the schools would rely heavily on the views of teachers to make changes.

"They (the teachers) are the foundation of the process," Harvey Gerry, the activity's education director, said during a telephone interview Thursday. "We have got to have the input from the people on the ground at the school because they know their school."

The decision that has set off the teachers' criticism was made by the leaders of DODDS parent organization, the Department of Defense Education Activity. They identified 16 schools in the military school system, including the six in Germany, whose scores on basic skills tests have been trailing behind those of other DODDS schools. Besides Schweinfurt Middle School, the other schools in Germany are Bad Kissingen Elementary, Gelnhausen Elementary, Wetzlar Elementary in Baumholder, Springfield Elementary in Hanau and Schweinfurt Elementary.

The school system plans to send teams of experts to assist with curriculum, seek more community involvement, modify programs and serve as a resource for teachers and staff members.

In preparation for the teams' arrival, DODDS officials have been holding meetings with parents and teachers such as the one held in Schweinfurt on Wednesday.

(Contributing to this report: Amee Seabolt in Washington, D.C.)

DODDS teachers planning to picket pay problems at Rome conference

By STEFAN ALFORD
Staff writer

There's a new lesson on the books for DODDS-Europe teachers — Picketing 101.

More than 50 teachers are planning to protest pay problems affecting Department of Defense Dependents Schools employees with picket signs at the U.S. Embassy in Rome on Nov. 15.

The picket is designed to draw attention to the plight of educators, whose pay has been harder to figure out than advanced trigonometry since the school year began in August. From missing entitlements and allowance to no paychecks at all, the instructors are victims of what they teach — the latest technology.

Conversion to a new Defense Finance and Accounting Service electronic pay system in July has left teachers raising their hands and asking "Why?"

"It's absolutely criminal the amount of confusion, anger, anxiety and energies that are being wasted as a result (of the pay problems)," said Ernie Lehmann, European director of the Overseas Federation of Teachers union. The OFT represents DODDS teachers in Italy, Turkey, Portu-

gal, Spain and Bahrain.

Despite the turmoil and mounting tension, the teachers are ever mindful of doing things by the book.

"This picket is a legal form of demonstration allowed in our contract to let people know about a labor dispute," said Lehmann. "This is a serious situation, and pickets are used only in the most extreme circumstances."

DODDS teachers can legally strike, but they are not ready to take such a drastic step and disrupt the educational system, said Lehmann.

"While morale is very low, our teachers are professionals and are going above and beyond to continue furnishing instruction," he said.

The embassy in Rome was chosen as the picket site because the union's annual fall convention takes place there that weekend, with delegates from all the countries affected present — including England and Germany.

The planned picket comes after several unsuccessful political attempts to remedy the pay crisis, including petitions, letters and phone calls to Defense Department officials, said Marie Sainz-Funaro, presi-

dent of the Overseas Federation of Teachers.

A letter from Lehmann to the White House on Monday cites specific examples of teachers affected and asks for President Clinton to intervene to resolve the pay concerns. The letter, a copy of which was faxed to The Stars and Stripes, cites "cruel and unusual punishment" to the 10,000 worldwide DODDS employees by officials in the personnel division and those in charge of the finance and accounting service.

Employee requests for assistance go ignored, unanswered and disregarded, the letter claims.

In a meeting with union representatives in Wiesbaden, Germany, last week, the DODDS-Europe chief of personnel said that the pay problems are being worked, but that it would take time.

"There's no question that the number of people we still have with payroll problems is unacceptable," said Hayden Horne. "We are making improvements but just not as quickly as we'd like to see."

In the meantime, teachers will be practicing their handwriting skills as they prepare the signs for their field trip.

Who is to blame?

I'm not sure if it is the teachers or DODDS. I have a dyslexic child who is 9 years old and can't read. My child has been tested and was approved for dyslexia training in the States. We get to Germany, and I'm told by John Avera (special education coordinator) from Würzburg, Germany, that DODDS doesn't recog-

nize dyslexia and that it doesn't have the knowledge of where to get the material. But as a parent, I can get this material.

I recently called Mr. Avera and asked if he could give me a written statement saying why DODDS doesn't recognize dyslexia and for whatever legal reason. He told me he couldn't. My hands are tied. My options are to leave my husband for 2 years and go back to the States, or stay here and let my child's continued learning go downhill.

I am upset that when children have problems, the school's solution is to put them on Ritalin because they must have Attention Deficit Disorder or Attention Deficit Hypertension Disorder.

I know of a few other parents who have dyslexic children. So my biggest questions are: Why doesn't DODDS recognize dyslexia? And why don't they give me a written statement saying it doesn't? I also would like to know — if it's not the teachers who are to blame, then who is?

Crystal R. Altman

Teachers offer plan to improve test scores

Most educators suggest smaller classroom ratios

By MICHAEL MADDOX
Würzburg bureau

SCHWEINFURT, Germany - The military's school system is taking the wrong approach to pumping up test scores at six schools in Germany, some educators say.

Instead of sending in experts to address the problem, these educators think the Department of Defense Dependents Schools should be looking to the classroom teachers themselves for help.

At a meeting Tuesday, the group of about 40 educators from schools in Schweinfurt and Bad Kissingen spelled out alternative ideas. Those ideas include:

- A lower student-teacher ratio.
- Increased numbers of specialists to help low achievers.
- Less time-consuming paperwork.

"There appears to be no concrete plan on what is going to be done as of yet," said Ingrid Ahlberg, a European area director of the teachers' union called the Federal Education Association. "The teachers are ready to offer some concrete suggestions

on ways to solve those problems."

In response to the teachers, DODDS headquarters vowed Wednesday that they would be heard.

"At the school level, the teachers, administrators, parents, and community will continue to develop and decide on the strategies and programs that are best suited to their school," the statement said.

The area's superintendent, John Davis, was unavailable for comment.

In Arlington, Va., a spokesman for the Department of Defense Education Activity said Wednesday that officials want to focus on helping the teachers. The spokesman, Jim Jarrard, said this focus could mean smaller class sizes and more specialists, but it is still too soon to determine what each school needs without a closer look.

The activity is DODDS' parent organization.

The educators are responding to the school system's plan to send the experts to 16 schools, six in Germany, where basic skills test scores have been trailing those of other DODDS schools. The six schools in Germany are: Schweinfurt Middle and Elementary, Bad Kissingen Elementary, Gelnhausen Elementary, Wetzlar Elementary in Baumholder and Sportfield Elementary in Hanau.

The experts are to assist the schools with

curriculum, seek more community involvement, modify programs, and serve as a resource for teachers and staff members.

Tuesday's meeting in Schweinfurt was the second such gathering held by educators seeking alternatives to the administration's plan. The first was held Feb. 13 at Gelnhausen Elementary. Both groups came to similar conclusions.

Most teachers agreed that spending money on studies and experts is the wrong approach. Instead, the teachers said the schools should reduce the student to teacher ratio to 18-to-1 for grades 1 through 3, and 23-to-1 for grades 4 through 6.

"Don't give us people telling us what to do, give us doers," said Mary Margaret McGowan, another European area director of the FEA. "Eighteen-to-one, twenty-three-to-one ratios, they'll give away everything else for that. The pupil-teacher ratio, teachers believe, is the most significant factor in being successful at teaching their children."

The average pupil-teacher ratio in the six schools involved in the review range from 13.6 to 25.3 for each teacher. The DODDS statement said the ratios could be addressed during the review by the experts.

Overall, though, ratios have been dropping at the schools in the past decade. In the 1990-1991 school year, the average ra-

tio was 20.8 students to one teacher, according to school documents. For the 1996-1997 school year, the ratio was 18.6-to-1.

In comparison, the ratios for all grades in schools in Fairfax County, Va., range from 24-to-1 to 28-to-1 for the 1997-1998 school year.

DODDS officials have said the two systems are comparable.

A lack of specialists is another issue that needs to be addressed, the teachers said.

"We don't have the staff we want to have for the kids who might be having some trouble academically," said Michael Priser, a Gelnhausen school psychologist. "Our staffing has been cut every year - the specialists who provide remedial reading help, remedial math help. There are no remedial math services at Gelnhausen."

Teachers also were concerned about the amount of their administrative work, McGowan said.

"We want to eliminate some of the paperwork. The teachers just want the time to teach, not to be loaded down with peripheral paperwork and constant reporting out. We spend more time reporting what we do than we actually get to do it," she said.

(Contributing to this report: staff writer Amee Seabolt in Washington, D.C.)

Please note a ratio does not tell you how many students are actually sitting in a teacher's classroom.

Experts coming to debug DODDS

By WARD SANDERSON

Staff writer

DARMSTADT, Germany — American military schools in Germany aren't broken, a top administrator says.

Six just need tuneups, and parents can expect the mechanics to arrive by March, said John Davis, superintendent for the schools throughout Europe.

Last week, school leaders announced that students at the six schools were lagging on basic skills tests. Now, administrators are holding meetings with parents, teachers and commanders to find out just why that is and to decide how the problems can be fixed. In March, those groups will be led by outside educators who specialize in debugging curricula.

Davis isn't sure who those experts will be, and he won't speculate as to why the schools stumbled. But he does defend the Department of Defense Dependents Schools-Europe.

"I think our schools compare very favorably with the better school systems in the United States," he said.

School leaders decided to send in the expert teams after reviewing students' scores on the Comprehensive Tests of Basic Skills and the TerraNova Multiple Assetments Tests.

The tests covered reading, language, math, science and social studies.

The schools whose scores need a boost are in the Würzburg, Hessen and Kaiserslautern districts. They are:

- Bad Kissingen Elementary School
- Gelnhausen Elementary School
- Wetzel Elementary School in Baumholder
- Sportfield Elementary School in Hanau
- Schweinfurt Elementary and Middle schools.

In addition to the six in Europe, nine other schools in the United States and one in Panama also need a boost.

In some cases, the schools scored well below the average score for military schools, which was about 65 percent. For example, third-graders at Gelnhausen Elementary scored a 29 in math.

Though Davis said it's too early in the process to point out why the marks are low, others have inklings. A spokeswoman for the Federal Education Association said some of the reasons might be young families, small schools, frequent family reassignments and deployed troops.

"We have populations that are shipped of to Bosnia ... (and) we have a different education background. Younger

people, people who haven't had opportunities for higher education," said Ingrid Aulberg, a Heidelberg-based director for the teachers' union.

Aulberg gave Wetzel Elementary in Baumholder as an example. "Baumholder was heavily deployed to Bosnia," Aulberg said. "It was to the point where DODDS had to bring in outside social workers and psychologists to work with children with special needs ... kind of like a crisis team."

Davis said none of these challenges is insurmountable. "As long as we have high expectations for our students, they'll do well, regardless."

Davis said most of the meetings will be held in the next two weeks. "Some of the communities have already done that," said Panzy Davis, a spokeswoman for DODDS Europe. "I know Kaiserslautern has already done one in their area."

According to the Hessen district superintendent's office, there will also be a meeting in the cafeteria at Gelnhausen Elementary School on Tuesday. The meeting for Sportfield Elementary is scheduled for Feb. 11 at the community center at Old Argonner Casern. Both meetings will be from 9 a.m. until 3:30 p.m. The Würzburg district's office said it didn't have a meeting currently scheduled.

Dissatisfied with DODDS

It's sad, but the letter "DODDS no bargain" (April 22) rang a sympathetic chord. I thought it was only my perception, but after talking to other parents, there is something drastically lacking with the Department of Defense Dependents Schools curriculum.

Let me say at the outset, I am not criticizing the teachers and staff of the schools. I know there are a lot of good teachers and administrators who are truly interested in providing our children with the best possible education. However, I believe their hands are tied regarding the curriculum.

We've been monitoring our first-grader's progress regarding the number and types of skills she is learning. One thing seems abundantly clear: The kids are not being sufficiently challenged and are capable of doing much more. It seems they spend an inordinate amount of time covering the same skills rather than being presented with new ones.

I'm certain that if DODDS responds to this letter it will point out how well it is doing in comparison with stateside schools. In my view, the bar has been set too low.

Why is it that many affluent families prefer to send their children to private schools? Why is it that American children score so poorly in math in comparison to most countries? My wife, who received a European education, is appalled at the differences in the two educational systems.

Not being content with the level of education my first-grader is receiving, we supplement her education at home. Consequently, she is now reading at the fourth-grade level. In addition, she gets a healthy exposure to math, science and social sciences. But not all parents have the time or resources to devote to their children's education. Why should parents have to supplement their child's education in the first place?

I would like to see the curriculum bar raised. I would like to see DODDS choose an appropriate school to serve as a model (either a private school or the European system). The curriculum of this model should be reviewed. The particular skills, associated with grade levels, should be identified, new textbooks and learning materials acquired and the curriculum adopted.

In the States, I'm certain we are going to see some initiatives to raise the level of excellence in our schools. The aforementioned math study set off some alarm bells on Capitol Hill. DODDS, here's your chance to get ahead of the game.

Jeffrey Sanger
Zweibrücken, Germany

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THE PRES

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Can we help
to them? Should
we? Advice
K-100 →

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HOUSE OF REPRESENTATIVES
WASHINGTON, D. C. 20515

DISTRICT
LOUISIANA

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THE PRESIDENT HAS SEEN
5-27-98

Mr. President:
Please recall my discussion
with you respecting your
support of an African American
led EPIC in
Africa.

5-27-98

I would draw
your attention
to the fact that
possible cost
it is approximately
\$50 million
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investments have for several months
now. I enclose a delegation letter
from representatives of my
State in support of the Fund.

Phil -
Should we send
Leg Affairs a copy?

Yes ☒

Did
power
call
yes

Sincerely

Congress of the United States
House of Representatives
Washington, DC 20515

May 6, 1998

Mr. George Munoz
President and CEO
Overseas Private Investment Corporation
1100 New York Avenue, N.W.
Washington, D.C. 20527-0001

Dear Mr. Munoz:

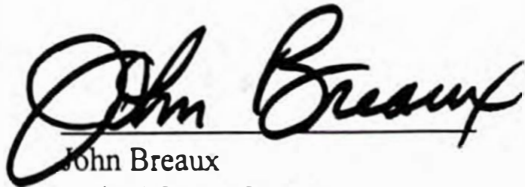
We wish to bring to your attention our support of OPIC's interest in establishing funds to invest in infrastructure and business development in Africa. Of the twenty-five such funds authorized by OPIC, totaling over \$3 billion in initial capitalizations, only three funds totaling \$295 million have been authorized for African investment. Since Africa returned the highest investment of any continent in the world last year, it is more than a moral imperative, it is simply good business for OPIC and U.S. investors, to facilitate U.S. investment in Africa.

In this regard, we are delighted to learn that three leading African American businessmen from our State of Louisiana - - Messrs. Alden McDonald, Norbert Simmons and James Smith - - have applied to OPIC to operate a fund to invest in Africa under the name "Continental Africa Equity Fund." Theirs is to be a leveraged fund, like most of the other funds OPIC has authorized, of \$150 million. The Continental Africa Equity Fund's \$150 million will be comprised of \$100 million to be loaned to the Fund by OPIC and \$50 million to be raised by Mr. McDonald, Simmons, Smith and others as general partners. Although, OPIC does not require that the general partners raise their matching portion of \$50 million prior to OPIC's approval, these general partners have already done so. They have also established a network of officers and a reliable organization of African investment specialists on the ground in three major locations on the African continent who can assist in identifying and managing investment opportunities in Africa. Their application for the Continental Africa Fund has been completed and has been pending since last November, well before the May 30, 1998 "Call" for other Africa fund proposals was made. They are hopeful that their application can be approved and voted upon before June 30, 1998 in accordance with the process for consideration of proposal that was in place at the time their application was submitted.

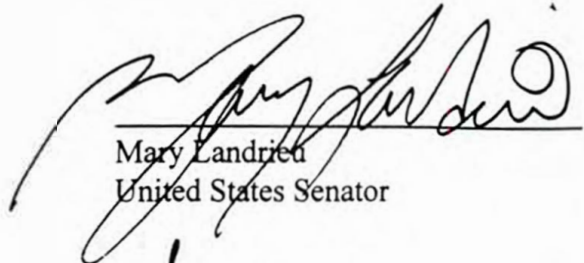
Mr. McDonald is the President of Liberty Bank & Trust Company, one of the largest, most successful African American banking institutions in our nation. Mr. Simmons is an investment banker and entrepreneur, heavily invested in the real estate, hospitality and gaming industries in our State. Mr. Smith is the President and CEO of SEMA, Inc., a high tech firm which employs

hundreds of workers in data processing and information technology. We are proud to commend these three leading citizens of our state and their project - - the Continental Equity Africa Fund - - to you and urge your consideration toward its approval.

Sincerely,



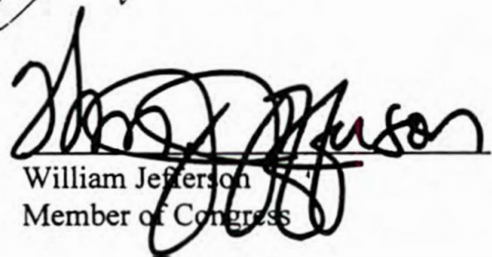
John Breaux
United States Senator



Mary Landrieu
United States Senator



Bob Livingston
Member of Congress



William Jefferson
Member of Congress

THE WHITE HOUSE
WASHINGTON

5-28-98

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The
Economist

AUGUST 16TH 1997

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India's next 50 years

SPEAKING to India's Constituent Assembly in Delhi on August 14th 1947, the eve of independence from British rule, the new nation's prime minister said:

We end today a period of ill fortune and India discovers herself again. The achievement we celebrate today is but a step, an opening of opportunity, to the greater triumphs and achievements that await us. Are we brave enough and wise enough to grasp this opportunity and accept the challenge of the future?

The truth is that, with one remarkable exception, the greater triumphs and achievements that Nehru looked forward to have eluded India these past 50 years. Churlish as it seems to point it out on this anniversary, India is further behind today, relative to the rest of the world, than it was at independence. Now, however, it stands at a new threshold, with greater triumphs and achievements once more in sight. Nehru's question seems no less apt than before: how brave and how wise will the country and its leaders be this time?

Of tigers and elephants

In what is otherwise an epic tale of wasted promise, one success of the past half-century shines out: India remains a democracy. Despite the legacy of colonialism, the horror of partition, the burden of poverty, and the curse of religious and caste strife, India's democracy has lasted—and despite being blemished by corruption, it is no sham, but real and vibrant. Those who argue that democracy is a western conceit fundamentally at odds with "Asian values" are refuted by the pride that Indians take in their political freedom, and by the energy with which they express it.

For the rest, the record until recently was one of barely qualified failure—of opportunities missed and challenges shirked. For 40 years, the economy grew so slowly that hundreds of millions remain to this day trapped in the direst poverty. India's governments did too much and too little: too much trade protection, unproductive subsidy and industrial planning (pursued in India with a surreal dedication unknown outside the communist world); too little education, infrastructure, and law and order. Some of this was Britain's legacy. The Raj brought in protection after 1918, and bequeathed a civil service which, with further development, became a remarkably effective stifler of enterprise. With time, though, India's failure was of its own leaders' making. Governments closed their eyes to the outside world, always telling themselves "India is unique", with ruinous consequences (see pages 17-20).

In recent years, this has changed. India's politicians—some of them, anyway—have discovered the international economy and have even come to see it as an opportunity. With the reforms of 1991-93, the economy has been opened to



trade and its industrial-planning machinery has been dismantled. Earlier this year, a liberal budget pushed the process on, with tax cuts and renewed deregulation of the economy. These days, state leaders travel the world drumming up foreign investment; ambitious young Indians would rather be businessmen than bureaucrats; and when you do meet a bright young official, he is more likely to have an MBA from Stanford or Chicago than a PhD on Marx's theory of value from the London School of Economics.

The economy is improving. After decades of "the Hindu rate of growth" (less than 4% a year), India's output has lately been rising at 6% a year or more. This could continue for many years. But given the energy and resilience of its people, India should be doing even better. The economy is only half-reformed. If the government could finish the job by privatising faster, withdrawing support from "sick units" and deregulating labour markets, India might grow at a tigerish 8% or 9% a year. Then the next 50 years, unlike the past 50, would visibly transform the lives not just of a minority but of the mass of the people.

Will it happen? Certainly there are many reasons why it might not. These further reforms are politically more demanding than the ones already carried out—and India, never forget, is a democracy. Strong leadership might help, but is nowhere to be seen. The United Front government is a weak coalition of regional parties, liable to split at any moment. Nehru's Congress party, a dynastic movement which governed for most of the past five decades and whose tacit support keeps the United Front in power, no longer seems capable of forming a government on its own. The one party that might be the Hindu-nationalist BJP—but its victory would call into question India's future as a secular republic more than it would inspire hope of faster economic development.

India is at a political as much as an economic threshold. The settlement reached at independence was more fragile than its 50 years' standing makes it seem. India's future still turns on the question of national identity—the problem that the agonies of partition failed to resolve, and in many ways served to aggravate. From that unanswered question flow the continuing demands for regional autonomy in Punjab and Kashmir; the country's troubled (but improving) relations with Pakistan and Bangladesh, the parts that were torn away in 1947; the BJP's strident assertion of a religious national identity; the decline of India's only national secular party; and the growing strength of narrow regional movements such as the ones that make up the United Front. Can the imperatives of social and economic advance be heard above this din of political turbulence?

Unlikely as it seems, perhaps they can. Nehru and his

INDIA AND PAKISTAN AT 50

Happy anniversary?

Partition in 1947 created two nations. Our first article deals with India, which has paid heavily for a failed economic experiment, but is justly proud of its political achievements. Our second article argues that Pakistan has done better than India economically, but worse politically

ON AUGUST 15th 1947, India became the first British colony to win independence. Its new leaders swore to make democracy work in a multi-religious, multi-lingual, multi-ethnic region that had never been under unified rule. In speeches to enthusiastic crowds around the country, they pledged to end poverty and help India regain its pre-colonial glory as a great economic power.

Today, the euphoria is gone. The champagne bottles will pop on the 50th anniversary of independence, but the bubbly will taste a trifle flat. At best, India has been a qualified political success and a barely qualified economic failure.

Indian leaders believed in 1947 that colonial exploitation had kept the country poor, and that when the British went, so would poverty. In fact 320m Indians remain below the poverty line today, almost as many as India's entire population was in 1947. A mistaken socialist experiment has cost India dear.

India's first prime minister, Jawaharlal Nehru, wanted to attack what he saw as the two main evils of the colonial era. The first was rural feudalism—under which princes and aristocrats creamed off one-fifth of national income while the poor starved, and were denied basic civil rights. The second evil, according to Nehru, was the de-industrialisation of India by the Raj. Before the British came, India and China were the world's biggest manufacturers. When the British left, India was relatively poor and backward. Nehru attributed this not to Britain's industrial revolution but to the net transfer of capital from India to its colonial master, which averaged 1.5% of GDP annually throughout the two centuries of the Raj. This transfer was financed because, throughout the colonial period, India had a persistent trade surplus with Britain, and thus exported capital. So Indian leaders regarded export-orientation as an instrument of colonial exploitation. And since colonial India's exports were overwhelmingly commodities, free trade was regarded



Nehru got it wrong

as a hypocritical ploy to force British manufactures on India while stifling local industry. Thus the colonial experience led Indian leaders to turn to autarkic socialism.

Nehru wanted an activist state to enact egalitarian laws, transfer land from the aristocracy to the peasants, and make India a great industrial power again. He succeeded, despite many shortcomings in land reforms, in gradually giving power to India's rural peasantry. The peasants re-elected Nehru repeatedly with massive majorities, convincing him of the need for

ever-more state activism.

Besides, state activism was fashionable at the time. Capitalism was widely seen as having failed between the world wars, while the Marshall Plan, Keynesian demand management and the rise of the welfare state seemed to vindicate government intervention. Rapid Soviet industrialisation made five-year plans look such a good idea that they were adopted even by anti-Soviet countries like South Korea and Taiwan, with the blessing of the World Bank.

Unlike future East Asian tigers, however, Nehru's India neglected primary education. He viewed universal literacy as socially desirable but not as a key economic input, and instead emphasised higher and technical education. A far-reaching consequence after 50 years is that India's literacy rate is a pathetic 52%, lower even than in Kenya (78%) or Tanzania (68%).

East Asian countries sometimes used state intervention to help support competitive private-sector giants. But Nehru, impressed by the Soviet model, wanted the public sector to capture the commanding heights of the economy. He saw industry, especially the heavy sort, as the key to prosperity, and thought the potential of agriculture and exports was limited. So he decided to protect industry heavily against trade, and left agriculture relatively unprotected. This implicit tax on agriculture skewed Indians' investment decisions. And the investment that flowed into industry was often wasteful because Nehru forsook export-orientation for import substitution, with no checks to ensure efficiency.

Under Nehru, GDP growth averaged 3.5% per year. This was almost three times as fast as the 1.3% averaged during the first half of the century under the Raj, and faster than Britain's own growth rate during its industrial revolution. Many economists the world over hailed India as a success, convincing Indian leaders that they had nothing to learn from free-marketeers in the West. Only much later did East Asia demonstrate that, in the new post-war conditions, growth of 3.5% was slow rather than fast. But by then Indian planners had become knowledge-proof.

Planning created a veritable jungle of controls on production, prices and employment. Companies could not sack workers or close down without permission, which was virtually never given. The planners regarded competition as wasteful because it allowed an excess number of competitors, and then forced some to close down. As they saw it, this caused unemployment and wasted capital. Instead, the

planners proposed a licensing regime that would create exactly the planned capacity in each industry, and keep it going no matter how badly it was run. The result was a proliferation of uneconomic units and corruption, and a collapse in productivity.

Nehru's daughter, Indira Gandhi, became prime minister in 1966, and in the next decade took the command economy

to new heights. Using the slogan *garibi hatao* (abolish poverty), she nationalised banks and several industries, increased price and trade controls, and squeezed foreign investment. This socialist economic agenda masked a private political one. The main opposition party at the time, the Swatantra Party, was led by a coalition of princes and businessmen. Mrs Gandhi

abolished the princes' principal source of income, "privy purses" (annual payments from the government as compensation for the loss of their fiefs) and imposed harsh income and wealth taxes on businessmen, whose cumulative effect at the margin exceeded 100%. *Garibi hatao* killed the Swatantra Party. Poverty, alas, survived.

Mrs Gandhi reversed Nehru's neglect of

Pakistan—wounded at birth

HOW does Pakistan's performance over the past 50 years compare with India's? Economically, better (its economy has grown faster and its GDP per head is higher); socially, worse (both adult illiteracy and infant mortality are higher in Pakistan than in India); politically, worse (it has been run by soldiers for nearly half its existence, and its democracy is consequently shakier than India's). And Pakistan also faces a big political problem which India does not: the problem of the mohajirs. It is a consequence of the way Pakistan was created and a sharp illustration of the Pakistanis' failure to build a successful nation.

Mohajir means refugee. The mohajirs are the people who came from India at partition, and their descendants. It was mohajirs—such as Pakistan's founder, Muhammad Ali Jinnah—who dreamed up the idea of a separate nation for Muslims, fought for its inception, and imposed it on the generally indifferent inhabitants of the north-western slice of India that became Pakistan.

At partition, the population of Karachi—the capital, main port and business centre—swelled from 400,000 to a million almost overnight, as Muslims arrived from all over India. Nothing but religion united them: they spoke different languages, wore different clothes, ate different food. Yet today they are regarded as the country's loudest "ethnic" group; for, as their forefathers in India regarded themselves as an oppressed minority and struggled for their political and economic rights, so the mohajirs are fighting in Pakistan.

To start with, the locals welcomed their Muslim brothers and sisters in the refugee camps. The scale of the influx, and the ease with which it was absorbed, was remarkable. The mohajirs, who were by and large better-educated than the indigenous population, piled into well-paid professional jobs in the federal government, which was then based in Karachi.

Things started to go wrong when Ayub Khan, a Pathan soldier, moved the capital to Islamabad in the 1960s (partly in order to wrest control of government

from the mohajirs). Then Zulfikar Ali Bhutto introduced quotas to ensure a "fair" ethnic distribution of university places and government jobs; but what looked fair to Sindhis, Baluchis, Punjabis and Pathans looked distinctly unfair to the well-educated mohajirs.

The mohajirs, who did not own land, and so consequently had no place in the traditional political and social structure, were now having their power-base in the civil service whipped from under them. Army rule shifted the centre of power further from them still, for the army is largely Punjabi and Pathan, and those groups reaped the benefits of soldierly rule.

The first generation of mohajirs mostly sat quiet, as first-generation immigrants, insecure in their new home, often do. The second generation was more restive. By the early 1980s, there was the genesis of a political movement—which Zia ul Haq noticed and cultivated as a counterweight to the Bhuttos' Pakistan People's Party.

The Mohajir Quami Movement (MQM) swept Karachi, wiping out the reli-

Neighbourhood watch

India and Pakistan compared, latest

	India	Pakistan
GDP per head, PPP\$	1,385	2,340
Literacy rates, %	52.1	37.8
Infant mortality, per 1,000	74.0	80.0
People per telephone	77.6	56.1

Source: Asiaweek

gious parties that had previously taken the mohajirs' votes. For the mohajirs, Islam, the motive force that had brought them to Pakistan, had become subsidiary to the country's ethnic divisions. So, for the purposes of local politics, Tamils, Gujaratis, Keralans and Bibaris were redefined as a single tribe, and began to behave as such.

Once in power in Karachi, the MQM behaved vengefully and autocratically towards other ethnic groups (who, altogether, make up around half of Karachi's population). In the early 1990s, it fostered torture cells and condoned murders. When Benazir Bhutto, then prime minister, sent paramilitaries to regain control of Karachi in mid-1995, they responded more brutally still. In the year after the paramilitaries moved in, some 2,000-3,000 people were killed. For a while, Karachi went quiet; and it seemed that the MQM had been beaten into the ground.

But back it comes again. Nawaz Sharif, the current prime minister, made a deal with the MQM—as Miss Bhutto did, and as he had done in the past. The MQM wants thousands of its people released from jail; it wants compensation for the victims of extra-judicial killings; it wants jobs kept open for its people in loss-making state corporations that are to be privatised. Mr Sharif is not delivering; and the violence has started up again, in a big way. Over the past three months, around 350 people have been killed.

Nobody has much of a solution. The only original thought, supported by some in and out of the mohajir movement, would be to take the politics out of business by creating a new provincial capital for Sindh, and to turn Karachi into a free port. That would be a sad irony; for the mohajirs would be opting for a sort-of separate state within the country they themselves created.



Rallying round the flag

agriculture and ushered in the green revolution. Nehru had left India dependent on food aid from America, heightening the sense of national humiliation that already prevailed after India's military defeat by China in 1962. Indira Gandhi's administration restored Indian pride by making the country self-sufficient in food, and by winning the 1971 war with Pakistan.

But this political triumph could not mask the failure of her command socialism to improve either economic growth or social justice. In her first stint of 11 years, the percentage of Indians below the poverty line remained as high as it had been at independence.

Enter liberalisation

It was clear by then to all parties that a new direction was needed. So the Janata Party government in 1977 began relaxing the most stringent controls. This creeping liberalisation was carried further by Mrs Gandhi in 1980-84, and further still by her son Rajiv in 1984-89. Limited reform, along with the improvement of agricultural productivity across the country, enabled GDP growth to accelerate to 5.5% per year in the 1980s. Poverty declined steadily for the first time since independence.

But there was a downside too. Competition between political parties at election time drove up subsidies and government spending of every kind. Implicit and explicit subsidies shot up from 8.2% of GDP in 1977-78 to almost 15% by 1987-88. State spending grew explosively, financed by a borrowing spree, internal and external. The fiscal deficit rose sharply, the trade deficit widened, and foreign debt quadrupled during the 1980s. India was on the verge of defaulting on its foreign debt in 1991 when a new reformist government, headed by Narasimha Rao, came to power.

Earlier, politicians of all parties had loved socialism for two unstated reasons—it enabled them to keep expanding public investment (useful for building patronage networks), and subsidies (which they saw as essential to get re-elected). The fiscal crunch now meant that neither the central nor state governments could expand both public investment and subsidies: they had to choose one or the other. They chose subsidies, across all parties. This necessarily meant turning to the private sector and foreign investors to take care of investment. The collapse of the Soviet Union showed that a further shift to the left was no solution. And so an astonishing transformation took place—the national consensus on socialism was replaced by one on liberalisation. An empty treasury forced politicians to turn, in sorrow-



Some habits die hard

ful confusion rather than ideological triumph, to the market.

Politicians remain reluctant to reduce subsidies, relax rigid labour laws or reform the public sector. Bankrupt state governments have no cash to invest in education, health and rural development. Yet this muddled reform has produced GDP growth averaging 7% in the past three years. That is well below India's potential, and means Indians will remain far poorer than they deserve to. Yet 7% is not to be sniffed at. India may be less than a tiger, but it is no longer a bumbling centipede.

Democracy flowers

Socialism failed, but Nehru's other experiment—in democratic nation-building—succeeded despite many flaws and travails. Democracy, a rare flower in the third world, has taken deep root in India. Indeed, it has proved to be the only way to reconcile the aspirations of so many conflicting groups.

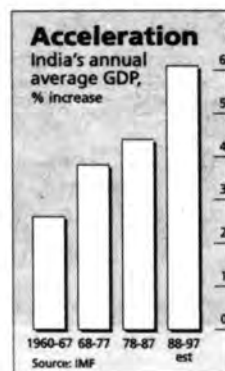
In 1947, sceptics wondered whether India would survive as a country. The British Raj directly ruled only two-thirds of the subcontinent—the rest was ruled by 600-odd princes. This huge region had five religions, 18 major languages and 93 minor ones. The Hindu majority itself was split into thousands of conflicting castes. Winston Churchill once dismissed India as a mere geographical expression, a place that was no more a nation than was the equator.

Indian independence was accompanied by partition (the Muslim-majority areas split away to form Pakistan) and unparalleled bloodshed from Hindu-Muslim violence. Half a million were

killed and tens of millions driven from their homes. In subsequent years, the Indian state was challenged by secessionists in Kashmir, Punjab, Tamil Nadu and the north-eastern states. It faced Maoist insurrections. It faced a thousand clashes based on religion, caste and region, yet it stayed intact and democratic.

In most colonies gaining freedom, the new leaders opted for autocracy or one-party rule on the ground that multi-party democracy would deepen social divisions and make governance impossible. India has proved the opposite—that democracy can allow a highly divided society to reconcile conflicting claims. The right to dissent keeps dissenters active in politics instead of driving them into insurrection. Secession in several Indian states has been tamed by a combination of force and political carrots—after a military crackdown, the rebels have been offered regional autonomy and a chance to rule through the ballot. This has not worked everywhere (Kashmir remains a running sore), and human rights have often been violated. Yet, on balance, India can look back with some pride at 50 years of democracy.

Between 1947 and 1989, the country was ruled almost continuously by the Nehru-Gandhi family. Single-family rule is rarely a prescription for democracy. But Nehru was a dedicated democrat who created institutions that ensured a wide sharing of power and provided a permanent, honourable place for dissent. He had no desire to create a dynasty, and was succeeded by Lal Bahadur Shastri. But Shastri died soon afterwards in 1966. Nehru's daughter, Indira Gandhi, won a hotly contested battle for the succession, largely because leaders of the Congress party thought they could manipulate her from behind the scenes. In fact, she turned out to be a master politician who split the party twice to assert



her complete supremacy.

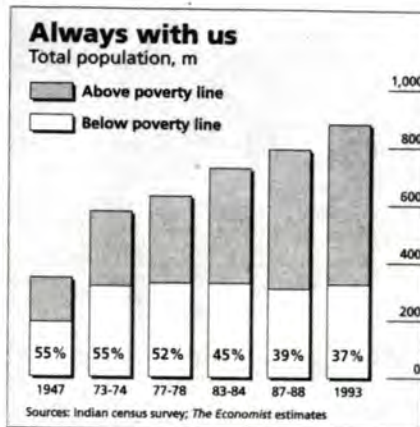
Mrs Gandhi was a ruthless centraliser of power who eroded many of the independent institutions her father had created. She converted her Congress party from the proud party of the independence movement into something that sometimes seemed little more than a bunch of family retainers. In 1975, a court disqualified her from holding office for a minor technicality in election expenditure. She responded by imposing an "emergency", suspending civil rights and jailing political opponents. In many developing countries, such a person would have gone on to become dictator for life. But Mrs Gandhi did not institutionalise the emergency. Instead she held a fair election in 1977 in which she was routed.

The rag-tag coalition of parties that ousted her soon fell apart. This enabled Mrs Gandhi to win the next election in 1980. Many of her supporters claimed this was a vote for a new emergency. But she found herself unable to shake off the Nehruvian tradition completely. So ingrained was her desire for public approbation that she stayed democratic. Indian democracy had proved its resilience.

A strong current of violence, however, continued to mar politics. Mrs Gandhi was assassinated by Sikh militants in 1984. Her son, Rajiv, won a landslide election victory later that year, leading some to believe that the Gandhi dynasty was unshakeably established. But the Congress party was rotting beneath the Gandhis' feet. Over four decades it had become increasingly corrupt. Other parties had grown steadily, and now ruled several states. Rajiv lost the 1989 election and was then himself assassinated by Tamil militants from Sri Lanka. Although some Congress party activists still hanker after bringing Rajiv's widow, Sonia, into politics, his death seems to have marked the end of the Gandhi dynasty.

With the passing of the Gandhis, India in the 1990s shifted from single-party rule to coalition politics. Earlier prime ministers were charismatic members of a charismatic family. But the most recent three—Narasimha Rao, Deve Gowda and now Inder Gujral—have been political lightweight who got the top job mainly because they were too lacklustre to have many enemies. This does not make for strong leadership. But a system that propels nonentities to the front does not lend itself to dictatorship either.

In the authoritarian parts of East Asia, India's democracy is sometimes blamed for its relative backwardness. But to democracy goes the credit for one of India's key achievements in the past 50 years—the conquest of mass starvation. This was a recurring problem in every drought, and thousands died in the twin droughts of 1965 and 1966, despite 21m tonnes of food aid. One much-discussed book of the time even



argued that India was fundamentally unviable and should be left to starve, conserving scarce food aid for savable countries.

Yet within a decade, India had conquered starvation. The credit for this is widely but mistakenly given to the green revolution. In fact food production between 1965 and 1980 grew by just 2.8% annually, no faster than in the preceding 15 years. Several developing countries, including many in Africa, fared much better.

India ended starvation by better distribution, not accelerated food production. A drought decimates agricultural activity and hence the earnings of farm labourers. Indians proved that if they are given purchasing power through employment schemes, they will survive even when food is scarce. In the Indian state of Maharashtra, in the early 1970s more food was available than in the Sahel. Yet there was famine in the Sahel but not in Maharashtra.

Apart from employment schemes, an affected country needs grain reserves, rural roads, and the ability to spot distress and move grain quickly. By the 1970s India had created all these facilities, but most African countries had not. The pressures of a free press and opposition parties in India

forced the government to act. Such pressures were rare in Africa.

A similar tale can be told of China, where about 30m people starved during the "Great Leap Forward" of 1958-60. China had no free press to give warning of impending disaster, no opposition demanding action. Instead it had sycophants unwilling to tell Mao how bad things were. In China, as in the Sahel, the needy were killed as much by a lack of democracy as by a lack of food.

The virtues of Indian democracy must not, however, be exaggerated. It may have helped prevent famine. But it has not prevented mass hunger, illiteracy, or policies guaranteed to keep people poor. Nor has democracy checked growing corruption and the emergence of a political class that is widely held in contempt by ordinary Indians. These days it is a common complaint in India that public services and government work only for those with money, muscle or influence.

In 1947, joining politics meant sacrificing your career for public service. Today, joining politics increasingly means joining the race for money, power and influence. Every political party now has links with gangsters, many of whom have elbowed their way into the legislatures. In some states the distinction between lawmakers and lawbreakers has virtually disappeared. A former home secretary estimates that in recent municipal elections hundreds of suspected criminals stood for election in Mumbai (formerly Bombay). Similar calculations were made by newspapers at the time of the Delhi elections earlier this year.

For all the flaws in India's democratic system, however, most middle-class Indians remain proud that their country can claim to be a rare democracy in the third world. If India can achieve economic success as well, the dreams of its founding generation may finally be fulfilled.



India's pageant unfolds

5-28-98

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The Embassy of the Czech Republic presents its compliments to the Department of State of the United States of America and has the honor to transmit herewith a thank you letter from Vaclav Havel, President of the Czech Republic, addressed to President Clinton, with the request that the letter be forwarded to her.

The Embassy of the Czech Republic avails itself of this opportunity to renew to the Department of State the assurances of its highest consideration.

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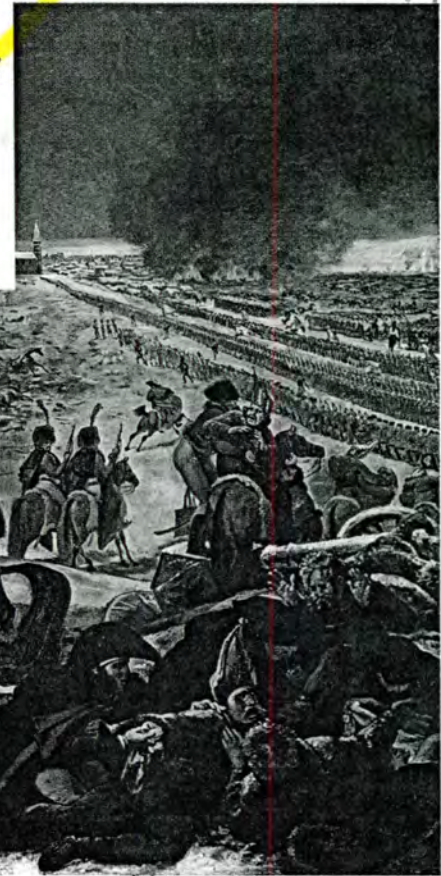
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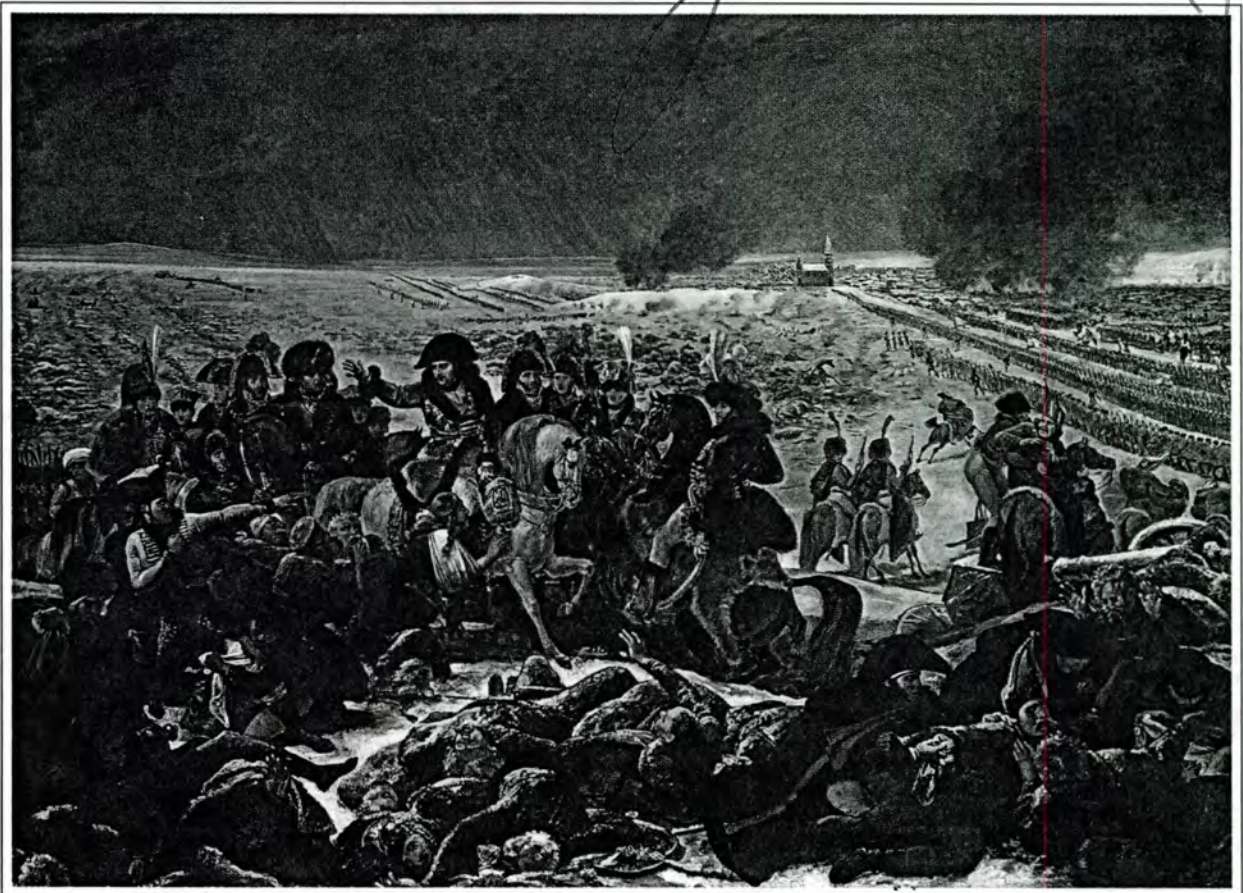
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Original Contributions

A Large Community Outbreak of Salmonellosis

Caused by Intentional Contamination of Restaurant Salad Bars 389

T. J. Török, R. V. Tauxe, R. P. Wise, J. R. Livengood, Atlanta, Ga;
R. Sokolow, S. Mauvais, Portland, Ore; K. A. Birkness, Atlanta, Ga;
M. R. Skeels, Portland, Ore; J. M. Horan, Atlanta, Ga; L. R. Foster, Portland, Ore

An Outbreak of *Shigella dysenteriae* Type 2 Among

Laboratory Workers Due to Intentional Food Contamination 396

S. A. Kolavic, Austin, Tex; A. Kimura, S. L. Simons, L. Slutsker, Atlanta, Ga;
S. Barth, Austin, Tex; C. E. Haley, Dallas, Tex

Special Communications

Clinical Recognition and Management of Patients

Exposed to Biological Warfare Agents 399

D. R. Franz, P. B. Jahrling, A. M. Friedlander, D. J. McClain, Fort Detrick, Md;
D. L. Hoover, Washington, DC; W. R. Byrne, J. A. Pavlin, G. W. Christopher,
E. M. Eitzen, Jr, Fort Detrick, Md

Biological Warfare: A Historical Perspective 412

G. W. Christopher, T. J. Cieslak, J. A. Pavlin, E. M. Eitzen, Jr, Fort Detrick, Md

Iraq's Biological Weapons: The Past as Future? 418

R. A. Zilinskas, College Park, Md

The Threat of Biological Weapons: Prophylaxis and

Mitigation of Psychological and Social Consequences 425

H. C. Holloway, A. E. Norwood, C. S. Fullerton, C. C. Engel, Jr,
R. J. Ursano, Bethesda, Md

Biological Terrorism: Preparing to Meet the Threat 428

J. D. Simon, Santa Monica, Calif

Commentaries

Why Should We Be Concerned About Biological Warfare? 431

R. Danzig, P. B. Berkowsky, Washington, DC

Botulism Surveillance and Emergency Response:

A Public Health Strategy for a Global Challenge 433

R. L. Shapiro, C. Hatheway, J. Becher, D. L. Swerdlow, Atlanta, Ga

Editorial

Infectious Disease and Biological Weapons:

Prophylaxis and Mitigation 435

J. Lederberg, New York, NY

The Cover 349

Antoine-Jean Gros, *Napoleon on the Battlefield of Eylau* M. T. Southgate

Abstracts 350 f

(Table of Contents continued on next page)

A Large Community Outbreak of Salmonellosis Caused by Intentional Contamination of Restaurant Salad Bars

Thomas J. Török, MD; Robert V. Tauxe, MD, MPH; Robert P. Wise, MD, MPH; John R. Livengood, MD; Robert Sokolow; Steven Mauvais; Kristin A. Birkness; Michael R. Skeels, PhD, MPH; John M. Horan, MD, MPH; Laurence R. Foster, MD, MPH†

Context.—This large outbreak of foodborne disease highlights the challenge of investigating outbreaks caused by intentional contamination and demonstrates the vulnerability of self-service foods to intentional contamination.

Objective.—To investigate a large community outbreak of *Salmonella* Typhimurium infections.

Design.—Epidemiologic investigation of patients with *Salmonella* gastroenteritis and possible exposures in The Dalles, Oregon. Cohort and case-control investigations were conducted among groups of restaurant patrons and employees to identify exposures associated with illness.

Setting.—A community in Oregon. Outbreak period was September and October 1984.

Patients.—A total of 751 persons with *Salmonella* gastroenteritis associated with eating or working at area restaurants. Most patients were identified through passive surveillance; active surveillance was conducted for selected groups. A case was defined either by clinical criteria or by a stool culture yielding *S* Typhimurium.

Results.—The outbreak occurred in 2 waves, September 9 through 18 and September 19 through October 10. Most cases were associated with 10 restaurants, and epidemiologic studies of customers at 4 restaurants and of employees at all 10 restaurants implicated eating from salad bars as the major risk factor for infection. Eight (80%) of 10 affected restaurants compared with only 3 (11%) of the 28 other restaurants in The Dalles operated salad bars (relative risk, 7.5; 95% confidence interval, 2.4-22.7; $P < .001$). The implicated food items on the salad bars differed from one restaurant to another. The investigation did not identify any water supply, food item, supplier, or distributor common to all affected restaurants, nor were employees exposed to any single common source. In some instances, infected employees may have contributed to the spread of illness by inadvertently contaminating foods. However, no evidence was found linking ill employees to initiation of the outbreak. Errors in food rotation and inadequate refrigeration on ice-chilled salad bars may have facilitated growth of the *S* Typhimurium but could not have caused the outbreak. A subsequent criminal investigation revealed that members of a religious commune had deliberately contaminated the salad bars. An *S* Typhimurium strain found in a laboratory at the commune was indistinguishable from the outbreak strain.

Conclusions.—This outbreak of salmonellosis was caused by intentional contamination of restaurant salad bars by members of a religious commune.

JAMA. 1997;278:389-395

OUTBREAKS of foodborne infection are caused by foods that are intrinsically contaminated or that become contaminated during harvest, processing, or preparation. It is generally assumed that such contamination events occur inadvertently; intentional contamination with a biologic agent is rarely suspected or reported.^{1,2}

On September 17, 1984, the Wasco-Sherman Public Health Department in Oregon began to receive reports of persons ill with gastroenteritis who had eaten at either of 2 restaurants in The Dalles, Ore, several days before symptom onset. Local and state public health officials confirmed an outbreak of *Salmonella* Typhimurium associated with the 2 restaurants and then noted an abrupt increase in reports of gastroenteritis the following week among persons who had eaten or worked at other restaurants in The Dalles. Because many patients reported eating food from salad bars, the local health department closed all salad bars in the town on September 25, 1984, and the Oregon Health Division requested assistance from the Centers for Disease Control (CDC) for further evaluation and control of the outbreak.

The epidemiologic investigation identified the vehicles of transmission as foods on multiple self-service salad bars and probable times when contamination occurred. Common mechanisms by which salad bars could have become contaminated were excluded. A subsequent criminal investigation found that members of a nearby religious commune had intentionally contaminated the salad bars on multiple occasions.

BACKGROUND

The Dalles, population 10 500 (1980 census), is the county seat of Wasco County, population 21 000, a region of orchards and wheat ranches. Located near the Columbia River on Interstate 84, The Dalles is a frequent stop for travel-

From the National Center for Infectious Diseases and Epidemiology Program Office, Centers for Disease Control and Prevention, Atlanta, Ga (Drs Török, Tauxe, Wise, Livengood, and Horan and Ms Birkness); and the Oregon Health Division, Portland (Messrs Sokolow and Mauvais and Drs Skeels and Foster). Dr Wise is now with the US Food and Drug Administration.

†Deceased.

Presented in part in the *Congressional Record*, February

28, 1985; 99th Congress, 1st Session: H901-H905, and at the Epidemic Intelligence Service 34th annual conference, Atlanta, Ga, April 23, 1985.

Trade names are used for identification only and does not imply endorsement by the US Department of Health and Human Services or the US Public Health Service.

Reprints: Thomas J. Török, MD, Centers for Disease Control and Prevention, Mailstop G-17, 1600 Clifton Rd NE, Atlanta, GA 30333.

ers. Two independent water systems serve The Dalles: a smaller system supplied by a well and a larger system that serves most restaurants and uses surface water augmented by well water during the summer. From 1980 through 1983, only 16 isolates of salmonellae were reported by the local health department; 8 isolates were *S Typhimurium*. No case of salmonellosis was reported in the first 8 months of 1984.

In 1981, followers of Bhagwan Shree Rajneesh purchased a large ranch in Wasco County to build a new international headquarters for the Indian guru.^{3,6} Construction of the commune was controversial from its inception; cultural values and land-use issues were the major areas of conflict. Part of the ranch was incorporated as the city of Rajneeshpuram, but the charter was challenged in the courts, effectively limiting new construction. Commune members believed that the outcome of the November 6, 1984, elections for Wasco County commissioners would have an important impact on further land-use decisions.^{3,6}

METHODS

Case Definition

A case was defined as an illness with diarrhea and at least 3 of the following symptoms: fever, chills, headache, nausea, vomiting, abdominal pain, or bloody stools, or by a stool culture yielding *S Typhimurium*. A patient was considered to have had an outbreak-associated case if onset of symptoms or collection of an *S Typhimurium*-positive stool specimen occurred between September 9 and October 10, 1984, and the patient resided in or had visited The Dalles during that interval. A case in a person who ate at a restaurant in The Dalles within 7 days before the onset of illness or who worked at a restaurant in The Dalles was considered to be a restaurant-associated case. A single restaurant exposure (SRE) denotes that only 1 restaurant exposure occurred during the 7 days before onset of symptoms. A case was considered to be secondary if it occurred in an individual who had not eaten or worked at a restaurant in The Dalles in the 7 days before onset of symptoms, but was exposed to a case patient during that interval.

The 38 restaurants in The Dalles were divided into 3 groups based on the number of culture-confirmed case customers with an SRE. Group 1 restaurants were definitely affected and had at least 3 culture-confirmed case customers with an SRE. Group 2 restaurants were possibly affected and had at least 1 case customer with an SRE, but fewer than 3 culture-confirmed case customers with an SRE.

Group 3 restaurants were not affected and had no case customers with an SRE.

Outbreak Investigation

Cases were identified through passive surveillance. Press releases encouraged reporting by case patients and health care professionals. We interviewed possible case patients about symptoms and risk factors and obtained comprehensive food histories for restaurant meals eaten during the 3-day period before onset of symptoms. Case customers with an SRE were asked to identify all other persons with whom they had eaten at the restaurant. Histories were obtained from persons so identified, and those who were not ill and reported no other restaurant exposure served as controls for food-specific case-control analyses. Potentially exposed cohorts, such as banquet participants and take-out food patrons, were identified from restaurant records, and attempts were made to interview these persons.

Employees of group 1 restaurants were interviewed twice. During the outbreak, investigators interviewed employees when restaurant involvement was first suspected. In October 1984, immediately following the outbreak, all employees were asked to complete a self-administered questionnaire. Work schedules were obtained from review of time cards, interviews with restaurant managers, and review of insurance claims for workers' compensation.

Laboratory Methods

Stool specimens were submitted to local and regional laboratories to be cultured for enteric pathogens. Employees from group 1 restaurants were required to submit a stool sample to be cultured or be excluded from work. Ill employees with a single negative stool specimen were required to submit a second stool specimen for confirmation before returning to work. The Oregon Public Health Laboratory and the Washington Public Health Laboratory serotyped human *Salmonella* isolates and performed antibiotic-susceptibility testing on a sample of isolates. A representative sample of outbreak isolates, based on epidemiologic criteria, was submitted to CDC for further biochemical characterization and plasmid profile analysis with restriction endonuclease digestion, using *HindIII*.^{6,7} The Oregon Public Health Laboratory also submitted *S Typhimurium* isolates from other outbreaks and sporadically occurring cases, collected during 1984 and thought to be unrelated to the outbreak, to CDC for comparison with the outbreak strain by plasmid analysis. The Oregon Department of Agriculture and the

Oregon Public Health Laboratory cultured suspected foods.

The Dalles outbreak strain was compared with human isolates included in 2 national surveys of salmonellae in 1979 and 1980 and in 1984 and 1985.^{8,9} To identify a possible animal reservoir, CDC characterized all available veterinary isolates of *S Typhimurium* identified between October 1, 1984, and September 30, 1985, by the US Department of Agriculture National Veterinary Services Laboratory in Ames, Iowa.

Environmental Studies

Local health department sanitarians and US Food and Drug Administration representatives investigated the distributors and original suppliers of foods used in group 1 restaurants. All group 1 restaurants were inspected by sanitarians. Records of the city water system were reviewed for the month of September 1984. Tap water samples were collected during the outbreak from restaurants for analysis. Temperatures maintained by ice-chilled salad bars were evaluated.

Statistical Analysis

Food exposure data were analyzed separately by restaurant and by date of onset of illness at the 2 restaurants that had recurrent outbreaks. Univariate analyses were performed and odds ratios (ORs) with 95% confidence intervals (CIs) were calculated using the Epi Info computer program Version 6.03.¹⁰ Foods found to be associated with illness in univariate analyses were analyzed using a stepwise logistic regression model. Univariate analyses of employee survey data were performed, and relative risks (RRs) with 95% CIs were calculated using Epi Info.

Criminal Investigations

Managers of affected restaurants were interviewed about unusual incidents or disgruntled employees. Suspicious events were referred to the Oregon State Police and the Wasco County sheriff for investigation. The Federal Bureau of Investigation (FBI) reviewed local investigation efforts. Following the completion of the epidemiologic investigation and after the collapse of the Rajneesh commune, the FBI, with technical assistance from the Oregon Public Health Laboratory, investigated clinic and laboratory facilities in Rajneeshpuram. A sample of *S Typhimurium* seized from the Rajneesh Medical Center on October 2, 1985, was compared with the outbreak strain.

RESULTS

We identified 751 patients who met the case definition; 441 patients (59%)

were female and 310 (41%) were male. Patients ranged in age from newborn to 87 years (median, 33 years). At least 45 persons (6%) were hospitalized; no fatalities were reported. The epidemic curve was biphasic (Figure 1). The first wave of illness, September 9 through 18, peaked on September 15, and the second wave, September 19 through October 10, peaked on September 24. Of 674 patients (90%) with known date of symptom onset, 88 (13%) became ill during the first wave and 586 (87%) became ill during the second wave. There were 692 restaurant-associated cases (92%), 11 secondary cases (1%), and 48 cases (6%) with incomplete information on restaurant exposure (Table). Among persons with restaurant-associated cases, 101 (15%) were employees and 591 (85%) were customers. There were 519 SRE case customers and 72 case customers with multiple restaurant exposures.

Ten of the 38 restaurants in The Dalles were definitely affected (group 1) (Table). Two group 1 restaurants had culture-confirmed SRE case customers in the early wave (restaurants A and B), but all 10 were affected in the late wave (Figure 2). These 10 restaurants were associated with 494 SRE case customers (95%), 69 case customers with multiple restaurant exposures (96%), and 91 case employees (90%). Twelve restaurants were possibly affected (group 2), accounting for 25 SRE case customers (5%). Three case customers with multiple restaurant exposures (4%) had reported eating at a group 2 restaurant but not at a group 1 restaurant. Sixteen restaurants were not affected (group 3). There was no geographic clustering of affected restaurants, but dates of exposure for culture-confirmed cases were clustered (Figure 2). Restaurant involvement in the outbreak was associated with operating a salad bar. Eight (80%) of 10 group 1 restaurants compared with only 3 (11%) of the 28 other restaurants in The Dalles operated salad bars (RR, 7.5; 95% CI, 2.4-22.7; $P < .001$).

Investigation of Illness Among Customers

The 4 group 1 restaurants where food-specific exposure rates were determined accounted for 283 (55%) of all 494 SRE case customers. Customer illness in all 4 restaurants was associated with eating from the salad bar. Restaurant A was affected during both waves of the outbreak, but different items on the salad bar were implicated for each wave. During the first wave, eating either macaroni, potato, four-bean, or pea salads was associated with illness (OR, 35.8; 95% CI, 4.2-1563.4; $P = .01$), and

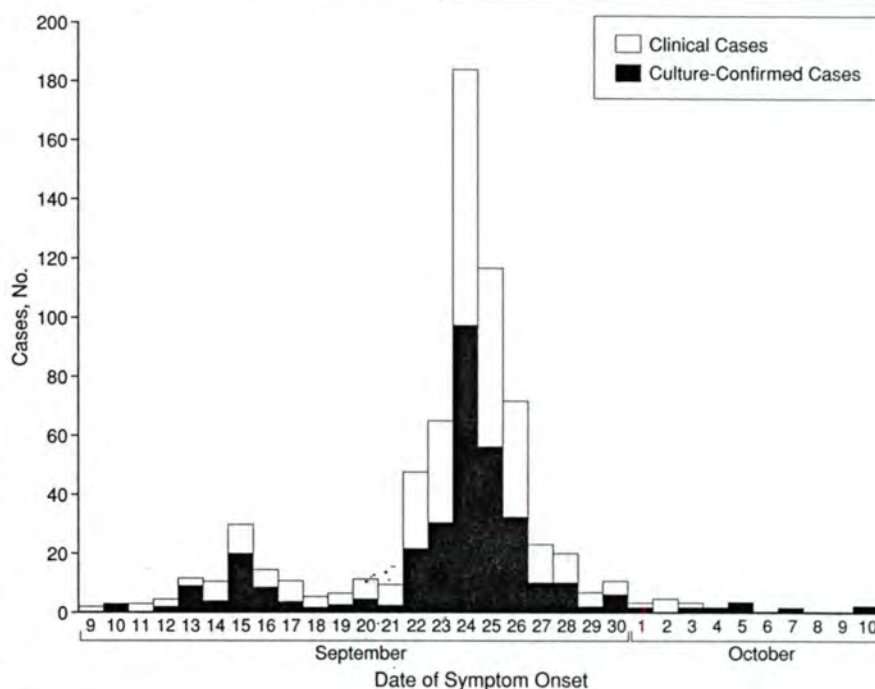


Figure 1.—Reported cases of *Salmonella* Typhimurium gastroenteritis by date of symptom onset for 674 cases (89.8%) with known date of onset, The Dalles, Ore, 1984.

Outbreak-Associated Cases of *Salmonella* Gastroenteritis by Group and Exposure Location

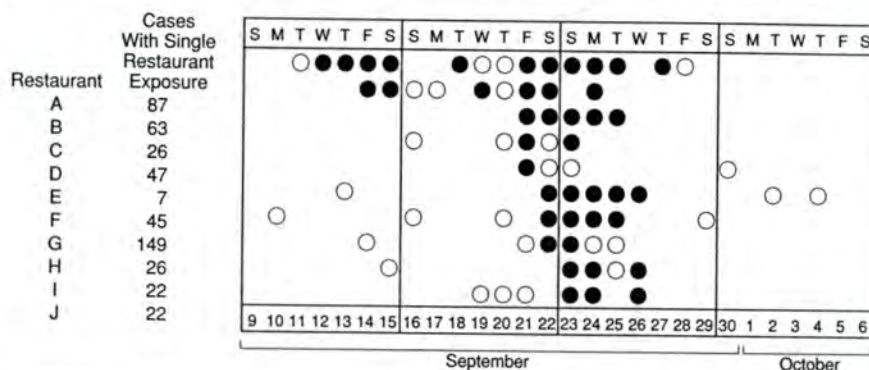
Group and Exposure Location	Culture-Confirmed Cases, No. (% of Total)	Clinical Cases, No. (% of Total)	Total Cases, No. (% of Total)
Case employees			
Group 1 restaurants (n=10)	74 (9.9)	17 (2.3)	91 (12.1)
Group 2 restaurants (n=12)	4 (0.5)	5 (0.7)	9 (1.2)
Group 3 restaurants (n=16)	1 (0.1)	0 (0.0)	1 (0.1)
Case customers			
Group 1 restaurants (n=10)	227 (30.2)	267 (35.6)	494 (65.8)
Group 2 restaurants (n=12)	6 (0.8)	19 (2.5)	25 (3.3)
Group 3 restaurants (n=16)	0 (0.0)	0 (0.0)	0 (0.0)
Multiple restaurant exposures*	32 (4.3)	40 (5.3)	72 (9.6)
Secondary cases	4 (0.5)	7 (0.9)	11 (1.5)
Cases with incomplete information	40 (5.3)	8 (1.1)	48 (6.4)
Total	388 (51.7)	363 (48.3)	751 (100.0)

*A total of 69 (95.8%) of 72 case customers with multiple restaurant exposures reported eating in 1 or more group 1 restaurants.

during the second wave blue cheese dressing was associated with illness (OR and 95% CI undefined because none of the noncase customers ate the blue cheese dressing; $P = .03$). Restaurants D and H were affected only during the second wave of the outbreak. By univariate analysis, lettuce (restaurant D: OR, 188.1; 95% CI, 37.0-1157; $P < .001$; restaurant H: OR, 31.2; 95% CI, 3.0-1417.3; $P < .001$) and many other salad bar ingredients were associated with illness at both restaurants. No independent risk for items other than lettuce was identified by multivariate analysis because most food items were eaten together as part of a lettuce salad. Restaurant G was affected only during the second wave of the outbreak. Potato

salad had the greatest association with illness (OR, 4.0; 95% CI, 1.5-11.2; $P = .005$), but could account for only half of the cases. Eating a lettuce salad was independently associated with illness (OR, 2.5; 95% CI, 1.0-6.2; $P = .04$). Eating take-out food from restaurant G, which did not usually include salad, was not associated with illness.

Although case-control studies of food exposures were not conducted at the other 6 group 1 restaurants, 4 had salad bars, with reported salad bar exposure rates for their SRE case customers ranging from 83% to 90%. The 2 restaurants without salad bars (restaurants E and J) accounted for the smallest number of case customers of all group 1 restaurants, 29 total (4%).



beef. That outbreak strain had a single plasmid similar to The Dalles strain, but no further laboratory comparisons were made. No links were identified between these outbreaks and the outbreak in The Dalles.

The 1979 to 1980 national survey included 233 strains of *S Typhimurium* (excluding variant copenhagen); none had antibiograms similar to The Dalles outbreak strain.⁸ The 1984 through 1985 national survey included 175 strains of *S Typhimurium* (excluding variant copenhagen); 35 strains had antibiograms similar to the strain from The Dalles, and 6 of these did not ferment dulcitol.⁹ One of the 6 strains was epidemiologically linked to The Dalles outbreak, but the other 5 isolates had no known link with the The Dalles outbreak.

Among 34 animal *S Typhimurium* isolates from the National Veterinary Services Laboratory collected from June 1984 through November 1984, 1 isolate that did not ferment dulcitol, collected from a turkey in June 1984, matched the outbreak strain by plasmid restriction endonuclease analysis.

Environmental Studies

Review of records at the municipal water department showed no evidence of water treatment failure in September 1984. Tap water samples from 10 restaurants were negative for bacteria and had acceptable turbidity readings, and 9 had chlorine residuals of at least 1.0 mg/L.

Detailed information on distributors and suppliers was collected for 8 of the group 1 restaurants. Of 40 food items served at 4 or more of the 8 restaurants, no supplier or distributor provided a single food for more than 4 restaurants. There was no common supplier or distributor for any of the foods served by the 2 restaurants involved in the first wave of illness. Many of the distributors served large areas in Oregon and Washington.

Sanitary inspections revealed minor violations of hygienic food-handling practices in some restaurants. Employees commonly put out fresh, full containers of a food item on the salad bar, but then placed the remainder from the old container on top of the fresh items. All salad bars were ice chilled. An evaluation of temperatures maintained on a typical ice-chilled salad bar showed that the surface of a bowl of potato salad was likely to reach 13°C to 16°C (55°F-60°F), which exceeds the maximal temperature of 7°C (45°F) recommended by the Food and Drug Administration. In 1 restaurant, there was no soap dispenser or towel in the employee rest room.

Criminal Investigation

During the criminal investigation, testimony by commune members indicated that the outbreak in The Dalles was the result of deliberate *S Typhimurium* contamination of salad bars in multiple restaurants by residents of Rajneeshpuram.¹³ Clandestine laboratories in Rajneeshpuram were used to prepare cultures of *S Typhimurium* that were poured on food items on salad bars and, in some restaurants, into coffee creamers. Commune members said they were testing a plan to incapacitate voters in preparation for an upcoming election. They intended to make citizens of The Dalles sick on election day to prevent them from voting and thus influence the outcome of the election. The information obtained from informant testimony was incomplete or insufficiently precise to allow direct comparison of dates of contamination with dates of exposure for case customers and case employees on a restaurant-by-restaurant basis. It is likely that some salad bars were contaminated more than once. Informant testimony did indicate that other restaurants, in addition to the 10 identified as group 1 restaurants, might have been targets and that other foods were deliberately contaminated. In addition, produce in at least 1 supermarket was contaminated with *S Typhimurium* and plans were made to contaminate city water.¹³

Oregon State and FBI investigators confiscated an open vial containing a standard strain of *S Typhimurium* (American Type Culture Collection 14028, Rockville, Md) from the clinic laboratory in Rajneeshpuram. Clinic records indicated that the laboratory had obtained this vial from a commercial supplier of biologic products before the outbreak. The *S Typhimurium* strain was indistinguishable from the outbreak strain by antibiogram, biochemical markers, plasmid profiles, and restriction endonuclease digestion of plasmid DNA.

On March 19, 1986, 2 commune members were indicted for conspiring to tamper with consumer products by poisoning food in violation of the federal antitampering act.^{12,13} In April 1986, the defendants pleaded guilty to the charges, and in July 1986 they were sentenced to 4½ years in prison, to serve concurrently with other sentences.¹⁴

COMMENT

This outbreak of salmonellosis, affecting at least 751 persons, was caused by intentional contamination of restaurant salad bars by members of a religious commune. It was the largest outbreak of foodborne disease reported to CDC in the United States in 1984. Despite extensive investigation, the source of *S Typhimurium*

initially went unrecognized. It was not until more than a year after the outbreak that sufficient evidence had accumulated to link the religious commune with the outbreak. Essential evidence was collected during the course of criminal investigations independent from the epidemiologic field investigation.

There was no evidence to suggest that the *S Typhimurium* was waterborne. Employee illness was not associated with water consumption, and affected restaurants were served by 2 different water systems. Unaffected restaurants shared the same water supply with affected restaurants. Water testing detected no evidence of contamination during the epidemic period.

The outbreak was clearly associated with food consumption at restaurants. Almost all case patients either worked at a restaurant in The Dalles or reported eating at 1 or more restaurants located in the town during the week before onset of illness. Many culture-confirmed cases occurred in nonresidents who had a single restaurant meal as their sole exposure. Self-service salad bars were implicated in transmission of *S Typhimurium*. Affected restaurants in The Dalles were much more likely to have a self-service salad bar than were unaffected restaurants, and eating food from self-service salad bars was highly associated with disease. Culture of salad dressing in 1 restaurant yielded the outbreak strain. The incidence of cases declined abruptly after all salad bars were closed, and this intervention may have terminated the outbreak. However, these findings were difficult to reconcile with the observations that sanitary practices in implicated restaurants were not grossly deficient, private banquets with salad bars were not affected, and no food sources were common to the majority of affected restaurants. Therefore, other possible modes of transmission were considered.

Transmission of nontyphoidal salmonellae from infected food handlers has been documented uncommonly in epidemiologic investigations.¹⁵⁻¹⁹ In The Dalles outbreak, infected food handlers may have contributed to the spread of infection by inadvertent contamination of foods at restaurants where they worked. Some ill employees continued to work until they were excluded by the health department. Direct contamination of foods by ill employees may have occurred at 1 restaurant without a salad bar because of the lack of soap and hand towels in the employee lavatory. In 1 affected restaurant with a salad bar, a case employee was identified who prepared the salad bar food items, including the implicated potato salad, and whose work schedule coin-

cided with the dates of exposure reported by case customers. Nonetheless, other findings suggested that contamination by employees was not the most important factor in transmission. Eating at restaurant salad bars was a risk factor for employees, not just customers. Exclusion of symptomatic and asymptomatic case employees occurred several days after the abrupt decline in new cases had begun, suggesting that exclusion of infected employees did not play a large role in terminating the outbreak.

Laboratory analyses were conducted that compared the outbreak strain with available human and animal isolates from national surveys. The characteristic antibiotic-sensitivity pattern, biochemical testing results, and plasmid analysis conclusively demonstrated a single outbreak strain and excluded the remote possibility of independent, simultaneous outbreaks. The outbreak strain was not common before the outbreak. None of the human isolates from the 2 national surveys, excluding several isolates obtained after the outbreak, matched The Dalles strain. The 1 animal isolate that matched the outbreak strain had no identifiable epidemiologic link to The Dalles outbreak. Isolates from 3 other 1984 Oregon outbreaks matched the outbreak strain, including a salad bar-associated outbreak which preceded The Dalles outbreak. However, no connection between these outbreaks and The Dalles outbreak was ever established.

The source of the outbreak strain of *S Typhimurium* was finally identified in October 1985. During a search by law enforcement agents, an Oregon Public Health Laboratory official found an open vial of commercial stock culture disks containing *S Typhimurium* in a clinical laboratory operated by the religious commune. Records showed that it was purchased before the outbreak,¹³ and laboratory testing during the following months demonstrated that the isolate matched the outbreak strain. Informant testimony provided additional information about the motives for the conspiracy and details of its implementation.^{5,12-14} Testimony indicated that several attacks were directed at some restaurants. In some restaurants, liquid coffee creamer was also contaminated, produce was contaminated in a grocery store, and plans were made to contaminate municipal water supplies.^{5,12-14} The epidemiologic investigation did not identify these other exposures as risk factors. The source of infection for employees who became ill before customer exposure was documented remains unknown. These illnesses may have been the result of an abortive early attempt at contamination. The informants indicated that the

saboteurs were frustrated when their initial attempts did not cause widespread illness and they may have used higher inoculums in later attacks.¹³

In retrospect, intentional contamination is consistent with the epidemiologic findings. When *S Typhimurium* was introduced into food on the ice-chilled salad bars, the holding temperatures may have permitted propagation; reuse of foods and addition of old products on top of new ones allowed *S Typhimurium* to persist for several days, and other foods on the salad bar may have been cross-contaminated. Intentional contamination explains why different foods were contaminated in different restaurants and the nearly simultaneous involvement of many restaurants despite the lack of common food sources. It also explains why persons attending private banquets at 2 affected restaurants did not become ill even though salad bars were set up for these events. Most importantly, intentional contamination explains the observations without relying on multiple complex modes of transmission.

The possibility that intentional contamination caused the outbreak was specifically considered early in the investigation, but this hypothesis was initially rejected for several reasons. (1) No motive was apparent. Despite concern in The Dalles about the potential for election fraud, the outbreak of illness in September and October was not obviously related with elections occurring in November. We had not considered that this incident had merely been a trial run for further attacks at the time of the election. (2) No one claimed responsibility for the incident, and no demands or ultimatums were issued. We assumed that if the motive was either extortion or terrorism, a public statement would have been issued to intimidate or create widespread fear. In fact, the incident was planned as a covert tactical strike. (3) Law enforcement officers investigated the few questionable activities reported among restaurant patrons and did not establish a recognizable pattern of unusual behavior. (4) No disgruntled employee was identified who might seek revenge on their employer. The criminal investigation confirmed that restaurant employees did not participate in the contamination efforts. (5) The epidemic exposure curves indicated that salad bars were contaminated multiple times during a several-week period, suggesting that a sustained source of *S Typhimurium* was necessary. It seemed more likely to us that a saboteur would have acted on 1 occasion, rather than risk repeated attacks and exposure. (6) A few employees had onset of illness before the recognized patron exposures in their restaurants. (7) To our knowl-

edge, such an event had never happened. We were aware of only 2 reports of foodborne illness caused by intentional contamination with biologic agents, and neither incident appeared to be politically motivated.^{1,2} (8) On the basis of our experience in other investigations, we believed that other hypotheses, although more complicated, appeared more likely, because individually each of the components had been well documented in other outbreaks. (9) Finally, even in thoroughly investigated outbreaks, the source sometimes remains occult, and, of all the reasons considered for failing to identify a source, this would be the most common.

There was a risk that publicity about this outbreak may have had the unfortunate side effect of inciting other events, similar to the cypoccat poisonings following the Tylenol-cyanide poisonings in 1982. When the cause of the outbreak was identified, it was reported by the regional news media; however, we know of no additional outbreaks motivated by these reports. A report of the findings of the CDC investigation was distributed to state and territorial public health officials, but not submitted for publication. The recent discovery of the stockpiling and use of biological agents by the Japanese cult Aum Shinrikyo serves to remind us of a continuing threat that biological weapons might be used by other terrorist groups in the future.²⁰ It is hoped that wider dissemination today of the epidemiologic findings from The Dalles outbreak will lead to greater awareness of the possibility of other incidents and earlier recognition, when or if a similar incident occurs. This potential benefit should outweigh the risk of a cypoccat incident. It may be that with a higher index of suspicion in The Dalles, the source of *S Typhimurium* would have been identified sooner. However, the epidemiologic method is inherently limited; it determines risk and association and can indicate how contamination probably occurred. It cannot establish motive.

Can another outbreak like the one that occurred in The Dalles be prevented? It seems unlikely that any regulation of commercially available pathogens could have prevented this outbreak. It would not be necessary to purchase them because this type of culture could be easily obtained from clinical isolates or from raw foods of animal origin available in grocery stores. Production of large quantities of bacteria is inexpensive and involves simple equipment and skills. Standard practices for maintaining salad bars may be inadequate to prevent similar outbreaks in the future with salmonellae or other pathogens. As in many areas of our open society, current practices are inad-

equate to prevent deliberate contamination of food items by customers.

With this in mind, the public is best protected when health care professionals and laboratories cooperate with local and state health departments to report notifiable diseases and unusual disease clusters. Routine reporting is essential in disease surveillance at both the local and national level, and efforts to improve surveillance will assist in the detection of future outbreaks in general. The epidemiologic approach to an outbreak need not be changed. The methods of determining the pathogen, vehicle, and route of contamination and

relating them to time, place, and person remain the same. On the basis of our experiences in The Dalles, we also suggest that if investigation of a large and cryptic outbreak implicates a mechanism of contamination that does not resemble established patterns, then the possibility of intentional contamination should be considered and law enforcement agencies should be asked to consider undertaking an independent investigation.

This article is dedicated to the memory of Laurence R. Foster, MD, MPH, in honor of his investigation of this outbreak and his inspirational leadership as Oregon State Epidemiologist.

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An Outbreak of *Shigella dysenteriae* Type 2 Among Laboratory Workers Due to Intentional Food Contamination

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Context.—*Shigella dysenteriae* type 2 is rare in the United States, and outbreaks associated with this pathogen are uncommon.

Objective.—To determine the magnitude and source of an outbreak of *S dysenteriae* type 2.

Design.—Retrospective cohort.

Setting.—Laboratory of a large medical center.

Patients.—Case patients were identified as laboratory workers who had diarrhea on or after October 28 and a positive stool culture or temperature greater than 37.8°C. Laboratory workers with diarrhea only were probable case patients.

Main Outcome Measures.—We interviewed laboratory staff and performed identification, serotyping, and pulsed-field gel electrophoresis on isolates from case patients, implicated food, and laboratory stock culture.

Results.—From October 29 through November 1, a total of 12 (27%) of 45 laboratory staff developed severe, acute diarrheal illness; 8 had *S dysenteriae* isolated from stool and 4 were hospitalized. All case patients reported having eaten muffins or doughnuts placed in the staff break room on October 29. Pulsed-field gel electrophoresis showed stool isolates from 9 case patients were indistinguishable from *S dysenteriae* type 2 recovered from an uneaten muffin and from the laboratory's stock strain, a portion of which was missing.

Conclusions.—The source of the outbreak was most likely the laboratory's stock culture, which was used to contaminate the pastries. Results of this investigation underscore the need for adequate precautions to prevent inadvertent or intentional contamination from highly pathogenic laboratory specimens.

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SHIGELLA dysenteriae type 2, also known as Schmitz bacillus, is a relatively rare organism that causes bacillary dysentery.¹ Although little historical information about this serotype is found in the medical literature, it was ap-

parently first described by Schmitz in 1917 after observing a winter epidemic of diarrhea in an eastern European prison camp during World War I.² Although outbreaks from this serotype were not common in the general population, outbreaks among patients in psychiatric hospitals in Wales were reported in 1938.³

Sporadic cases and outbreaks of *S dysenteriae* type 2 infection are now uncommon in developed countries.⁴ During the late 1980s a small outbreak occurred among family members in Sicily, where *S dysenteriae* type 2 had not been reported since 1953.⁵ Surveillance data from 1985 through 1995 from the US Centers for Disease Control and Prevention indicate that an average of about 20 individual cases of *S dysenteriae* type 2 are reported annually in the United States. The last reported outbreak in the United States occurred in 1983 among cafeteria workers in a Maryland medical center.⁶

Illness caused by *S dysenteriae* type 2 is not well described. Although it may cause significant morbidity, *S dysenteriae* type 2 appears to cause a milder illness compared with *S dysenteriae* type 1.¹ Unlike *S dysenteriae* type 1, which is associated with hemolytic uremic syndrome and toxic megacolon, *S dysenteriae* type 2 does not produce Shiga toxin.^{7,8}

BACKGROUND

From October 29 through November 1, 1996, 12 laboratory workers at a large medical center in Texas experienced a severe gastrointestinal illness after eating muffins and doughnuts anonymously left in their break room between the night and morning shifts of October 29. After stool cultures from these persons revealed *S dysenteriae*, all local emergency departments and infectious disease physicians were alerted and urged to report any additional cases. This article describes the findings of our investigation to characterize the magnitude and source of this outbreak.

METHODS

We defined a case patient as a laboratory worker with a diarrheal illness beginning on or after October 29, 1996, with a positive stool culture for *S dysenteriae* or an oral temperature greater than 37.8°C. A laboratory worker with diarrhea alone, with an oral temperature 38°C or less, or a negative stool culture was a probable case patient. We interviewed laboratory personnel who worked during the morning and night shifts and assessed demographics, food histories, social activities, and signs and symptoms of illness.

Stool was cultured on eosin methylene blue and xylose lysine desoxycholate agar media, then sent with a food specimen to the Bureau of Laboratories of the Texas Department of Health for further analysis and serotyping. The medical center's stock culture was also sent to the Texas Department of Health. Food was analyzed using established

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procedures from the *Bacteriological Analytical Manual* from the Food and Drug Administration.⁹

In addition, pulsed-field gel electrophoresis was performed on the food and stool *S dysenteriae* type 2 isolates and the hospital stock culture on *Xba* I and *Not* I (New England BioLabs, Beverly, Mass) chromosomal DNA digests. The fragments were separated using a CHEF-Mapper [clamped homogenous electric field] (BIO-RAD, Hercules, Calif), and the isolates were visually compared. All epidemiologic data were collected onto standardized forms, entered into a computer, and analyzed using Epi Info Version 6 software.¹⁰

RESULTS

We interviewed 45 laboratory employees who worked during the first or third shifts. Six laboratory workers were unavailable for interview, and 1 refused to participate; however, according to co-workers, 6 of these persons were not ill and did not eat pastries. One unavailable

worker was reportedly ill, but attempts to confirm this were unsuccessful.

Laboratory employees recalled that during the night and morning shift change on October 29, an unsigned e-mail from a supervisor's computer appeared on laboratory computer screens with an invitation to eat pastries in the laboratory break room. The supervisor was temporarily away from the office at the time the message was sent. The break room is separate from the laboratory and cannot be accessed without entering a numerical security code. Two boxes of commercially prepared pastries containing blueberry muffins and assorted doughnuts were available.

Twelve workers who ate muffins or doughnuts reported diarrhea with fever, headache, or vomiting. Eleven met the definition for case patients, and 1 was a probable case patient. The mean age of the ill workers was 41 years (range, 33-52 years) and 9 (75%) were women. Ill persons reported having eaten a pastry on October 29 between 7:15 AM and 1:30 PM. Additionally, 1 worker did not eat a muffin at work, but took it home and shared it with a family member around 7 PM. The onset of diarrhea among the laboratory workers occurred between 9 PM on October 29 and 4 AM on November 1 (Figure 1). The mean incubation period until onset of diarrhea was 25 hours (median, 18 hours; range, 11-66 hours) and was preceded by nausea, abdominal discomfort, and bloating. Eleven patients were examined by a physician, while 1 consulted a physician by telephone. Five workers were treated in emergency departments and released, and 4 other patients were hospitalized (mean, 4 days; range, 2-10 days). Eight patients received intravenous fluids. Stool cultures were obtained from 11 ill workers; 8 cultures yielded *S dysenteriae* type 2, and 3 were negative. The *S dysenteriae* isolates were sensitive to all antibiotics tested for antimicrobial susceptibility. Eleven patients were treated with ciprofloxacin, and 1 re-

ceived a homeopathic medication. No deaths occurred among the ill workers.

The attack rate was 100%. All 12 persons who ate pastries became ill, vs none of 33 persons who did not eat pastries, resulting in an undefined relative risk for shigellosis among those who ate pastries ($P < .001$). There was no increased risk from eating food from the break room refrigerator or drinking any beverage, including coffee, tap water, or other drinks. Similarly, eating in the hospital cafeteria or attending social gatherings during the week of October 25 through 31 was not associated with a higher risk for disease.

Although no secondary transmission of the illness was observed, a family member of 1 worker became ill after eating a muffin that was brought home from the laboratory's break room. The worker reported ingesting some crumbs and also became ill. Stool cultures from the worker and family member yielded *S dysenteriae* type 2.

Our investigation of the storage freezer in the laboratory suggested that the reference culture of *S dysenteriae* type 2 had been disturbed. The laboratory stores various reference cultures, including *S dysenteriae* type 2 in Microbank vials, a low-temperature storage system for microorganisms. Each vial contains 25 porous, doughnut-shaped beads that can be impregnated with microorganisms. The *S dysenteriae* type 2 culture, which had been stored by the laboratory for several years, had been transferred to Microbank vials during the 1980s. During the outbreak investigation, the *S dysenteriae* type 2 vial was discovered to have only 19 beads, although it had reportedly never been used.

Shigella dysenteriae type 2 was isolated in virtually pure culture from *Shigella* broth enrichment cultures of the muffin specimen. *Shigella dysenteriae* type 2 was also isolated from stools of 8 patients. Additionally, *S dysenteriae*

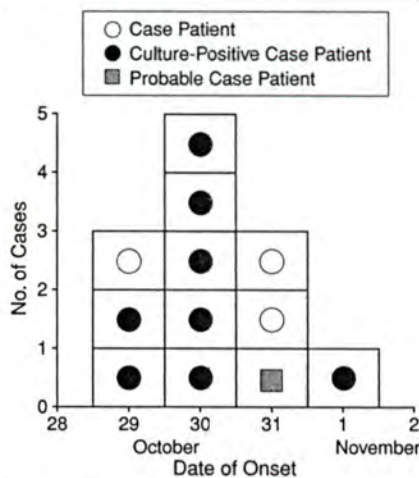


Figure 1.—Cases of shigellosis by onset of diarrhea among laboratory workers in a Texas medical center, 1996.

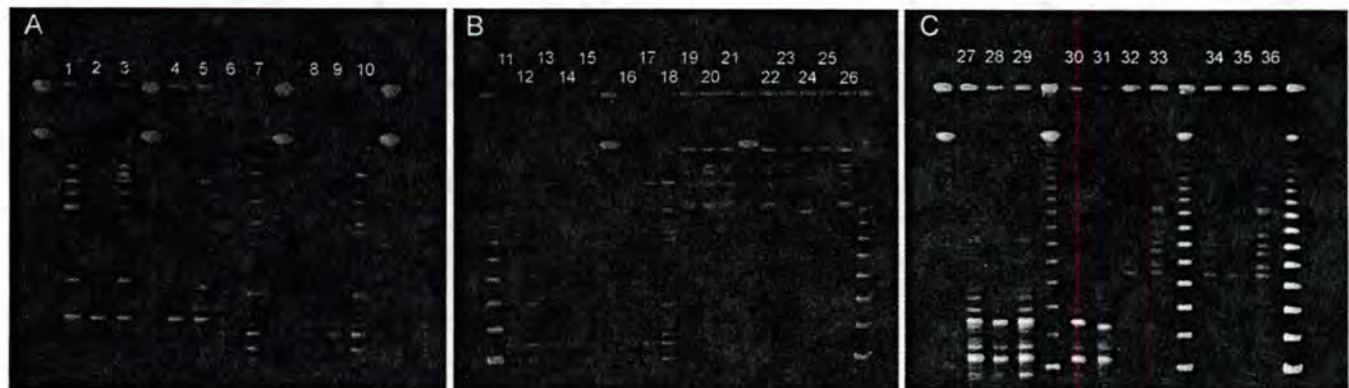


Figure 2.—Pulsed-field gel electrophoresis patterns from *Shigella dysenteriae* isolates. *Xba* I restriction digests—*S dysenteriae* type 3 isolates: 1-5 (panel A); *S dysenteriae* type 2 isolates: case isolates, 6, 8-15 (panels A, B); hospital stock culture, 7 (panel A); muffin isolates, 17, 18 (panel B); and nonoutbreak isolates, 16 (panel B). *Not* I restriction digests—*S dysenteriae* type 3 isolates: 27-31 (panel C); *S dysenteriae* type 2 isolates: hospital stock culture, 19-23, 32, 34-36 (panels B,C); muffin isolates, 25-26 (panel B); and nonoutbreak isolates, 24 (panel B).

type 2 was confirmed in the medical center's reference culture. Pulsed-field gel electrophoresis revealed that the reference culture isolates were indistinguishable from those of the muffin and the stool cultures, but differed from 2 non-outbreak isolates of *S dysenteriae* type 2 from other Texas counties in 1995 and 1996 (Figure 2). The outbreak strains differed from the nonoutbreak strains by more than 5 bands. Useful information was not obtained on the dose of *S dysenteriae* type 2 in the food sample.

COMMENT

The source of the organism was most likely the medical center's own stock culture of *S dysenteriae* type 2. There is a strong epidemiologic link between the ill persons, the uneaten food, and the laboratory's stock culture of this rare pathogen. All persons who developed shigellosis reported the same exposure (eating pastries). The stock culture and isolates from the stool and food sample were indistinguishable by pulsed-field gel electrophoresis, which has been shown to be highly discriminatory in subtyping strains of *Shigella sonnei* and many other enteric organisms.¹¹⁻¹³ *Shigella dysenteriae* type 2 isolates are uncommon in the United States and only 2 nonoutbreak strains existed in the Texas Department of Health's laboratory collection. These nonoutbreak type 2 strains and 5 type 3 strains also were analyzed and differed from the outbreak strain by more than 5 bands each.

The medical center's stock culture of *S dysenteriae* type 2 had been stored by the laboratory for years, and details of its origin are unclear. However, it was not a commercially prepared culture. The culture may have been obtained from a patient and previously used for

medical technician training. No cases of *S dysenteriae* type 2 had been diagnosed in the hospital laboratory during the past 5 years, and no research was being conducted with this pathogen. Therefore, a gross laboratory error seems an unlikely cause of this outbreak.

Contamination of the pastries during commercial handling also seems unlikely. No additional cases were reported, despite prompt contact with all area emergency departments and infectious disease physicians. In addition, no concurrent outbreaks of *S dysenteriae* type 2 were reported in Texas or any other state in the United States. A recall of the pastry products was not requested.

Although the motive and method of contamination are still unknown, the most likely hypothesis is that it was done by someone who had access to the freezer, had the laboratory skills to culture the organism from the beads and inoculate the pastries, and had access to the locked break room. Although we were unable to determine the dose of *S dysenteriae* type 2 added to the food sample, only 10 to 100 organisms are necessary to cause shigellosis infections in humans.⁷ As of this writing, a criminal investigation is ongoing.

The medical center has implemented security measures to safeguard against future incidents of this type. The laboratory freezer is now secured and must be unlocked by a supervisor to gain entry. Stock culture labels no longer identify microorganisms by name and have been replaced by a numerical identification system.

To our knowledge, this is the first reported intentional contamination of food items with *S dysenteriae* type 2. Bioterrorism through food contamination with

microorganisms rarely is reported in the scientific literature and reports appear about once each decade. During the mid 1960s, several outbreaks of typhoid fever and dysentery in Japanese hospitals were traced to food contaminated by a research bacteriologist who later infected family members and neighbors.¹⁴ In 1970, 4 Canadian university students became ill with pulmonary infiltrates, asthma, and eosinophilia after eating food maliciously contaminated with embryonated *Ascaris suum* ova, a large ringworm infecting pigs.¹⁵ Later, in 1984, multiple *Salmonella* outbreaks in Oregon were suspected to be caused by intentional contamination of restaurant salad bars.^{16,17} Details of this outbreak are reported by Török et al¹⁸ elsewhere in this issue.

The results of this investigation underscore the biological threat that accompanies malicious use of pathogenic microbiologic agents. Although no system can provide absolute security, measures to reduce the risk of such occurrences might include controls similar to those implemented by the medical center described in this article. These include controlled access to laboratory areas where these materials are stored, locked freezers that can be opened only by designated personnel, and maintenance of a written record of persons entering these areas and handling these materials. Guidelines should be established for secure storage and close surveillance of laboratory stock cultures.

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Clinical Recognition and Management of Patients Exposed to Biological Warfare Agents

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Concern regarding the use of biological agents—bacteria, viruses, or toxins—as tools of warfare or terrorism has led to measures to deter their use or, failing that, to deal with the consequences. Unlike chemical agents, which typically lead to violent disease syndromes within minutes at the site of exposure, diseases resulting from biological agents have incubation periods of days. Therefore, rather than a paramedic, it will likely be a physician who is first faced with evidence of the results of a biological attack. We provide here a primer on 10 classic biological warfare agents to increase the likelihood of their being considered in a differential diagnosis. Although the resultant diseases are rarely seen in many countries today, accepted diagnostic and epidemiologic principles apply; if the cause is identified quickly, appropriate therapy can be initiated and the impact of a terrorist attack greatly reduced.

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THE BREAKUP of the Soviet Union, the perceived dominance of the United States as a conventional military world power, and the rise of radical groups focused on destroying what they believe to be evil have raised concern regarding the use of biological warfare (BW) against military forces in combat and even as a new tool of terrorists against civilians.

The potential impact of biological weapons is well illustrated by a 1970 World Health Organization (WHO) publication.¹ It is estimated that 50 kg of aerosolized *Bacillus anthracis* spores, for example, dispensed by an airplane 2 km upwind of a population center of 500 000 unprotected people in ideal me-

teorological conditions would travel more than 20 km and kill or incapacitate up to 220 000 people, nearly half of those in the path of the biological cloud. If *Francisella tularensis* were dispensed, the number of dead or incapacitated would be about 155 000. Thus, if properly used as offensive weapons under ideal meteorological conditions, certain biological agents could cause mass casualties.

In addition to their detrimental health effects on the targeted population, the hostile use of BW agents would be likely to cause significant impacts on the health care system. Patients would present in unprecedented numbers, and demands for intensive care might overwhelm medical resources. Special medications or vaccines not generally available in standard pharmaceutical stocks potentially would be required. Health care professionals and laboratory personnel might need added physical protection, and autopsy and interment of remains could present unusual hazards.

The medical response to the threat or use of biological weapons differs depending on whether medical measures are used before exposure or after exposure and whether symptoms are present. If provided before exposure, active immunization or prophylaxis with antibiotics

may prevent illness. Active immunization is probably the best modality for future protection of military forces against a wide variety of biological threats. For civilian populations, preexposure medical countermeasures would likely not be used. After exposure, but before symptoms arise, active or passive immunization, as well as pretreatment with therapeutic antibiotics or antiviral drugs, may ameliorate disease symptoms. After onset of illness, only diagnosis of the disease and general supportive care plus specific medical treatment are left to health care providers. Effective vaccines and antitoxins exist for several of the most likely BW agents. Additional vaccines and new therapies are under development.

Information on diagnostics, medical management, and vaccines is available by contacting Commander, USAMRIID, at 301-619-2833 . . .

Bacteria, viruses, or toxins (of microbial, plant, or animal origin) may be used as BW agents. Examples of microbial agents and toxins that could be used as BW agents include *B anthracis* (anthrax), botulinum toxin, *Yersinia pestis* (plague), staphylococcal enterotoxin B (SEB), and Venezuelan equine encephalitis (VEE) virus. Despite the very different characteristics of these organisms and toxins, these agents used as weapons share some common characteristics. They can be dispersed in aerosols of particle size approximately 1 to 10 µm, which may remain suspended (in certain weather conditions) for hours and, if inhaled, can penetrate into distal bronchioles and terminal alveoli of the exposed. The aerosols may be delivered by simple technology, including industrial sprayers with nozzle and energy source modi-

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The views, opinions, and findings contained herein are those of the authors and should not be construed as an official US Department of the Army position, policy, or decision unless so designated by other documentation.

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Agent	Infective Dose (Aerosol)	Incubation Period	Diagnostic Samples (BSL)*	Diagnostic Assay	Patient Isolation Precautions	Chemotherapy (Rx)
Anthrax	8000 to 50 000 spores	1-5 d	Blood (BSL-2)	Gram stain Ag-ELISA, Serology: ELISA	Standard precautions	Ciprofloxacin 400 mg IV q 8-12 h Doxycycline 200 mg IV, then 100 mg IV q 8-12 h Penicillin 2 million units IV q 2 h plus streptomycin 30 mg/kg IM qd (or gentamicin)
Brucellosis	10-100 organisms	5-60 d (occasionally months)	Blood, bone marrow, acute and convalescent sera (BSL-3)	Serology: agglutination Culture	Standard precautions Contact isolation if draining lesions present	Doxycycline 200 mg/d PO plus rifampin 600-900 mg/d PO x 6 wk
Plague	100-500 organisms	2-3 d	Blood, sputum, lymph node aspirate (BSL-2/3)	Gram or Wright-Giemsa Stain Ag-ELISA, Culture, Serology: ELISA, IFA	Pneumonic: droplet precautions until patient treated for 3 d	Streptomycin 30 mg/kg IM qd in 2 divided doses x 10 d (or gentamicin) Doxycycline 200 mg IV then 100 mg IV q 12 h x 10-14 d Chloramphenicol 1 g IV q 6 h x 10-14 d
Q fever	1-10 organisms	10-40 d	Serum (BSL-2/3)	Serology: ELISA, IFA	Standard precautions	Tetracycline 500 mg PO q 6 h x 5-7 d Doxycycline 100 mg PO q 12 h x 5-7 d
Tularemia	10-50 organisms	2-10 d	Blood, sputum, serum EM of tissue (BSL-2/3)	Culture Serology: agglutination	Standard precautions	Streptomycin 30 mg/kg IM qd x 10-14 d Gentamicin 3-5 mg/kg/d x 10-14 d
Smallpox	Assumed low (10-100 organisms)	7-17 d	Pharyngeal swab, scab material (BSL-4)	ELISA, PCR, virus isolation	Airborne precautions	Cidofovir (effective in vitro)
Viral encephalitides	10-100 organisms	VEE, 2-6 d EEE/WEE, 7-14 d	Serum VEE (BSL-3) EEE (BSL-2) WEE (BSL-2)	Viral isolation Serology: ELISA or hemagglutination inhibition	Standard precautions (mosquito control)	Supportive therapy analgesics anticonvulsants as needed
Viral hemorrhagic fevers	1-10 organisms	4-21 d	Serum, blood Most viral hemorrhagic fevers (BSL-4) RVF, KHF, and YF (BSL-3)	Viral isolation Ag-ELISA RT-PCR Serology: Ab-ELISA	Contact precautions Consider additional precautions if massive hemorrhage	Supportive therapy Ribavirin (CCHF/arenaviruses) 30 mg/kg IV initial dose 15 mg/kg IV q 6 h x 4 d 7.5 mg/kg IV q 8 h x 6 d Antibody passive for AHF, BHF, Lassa fever, and CCHF
Botulinum	0.001 µg/kg (type A)	1-5 d	Nasal swab (possibly) (BSL-2)	Ag-ELISA, Mouse neutral	Standard precautions	DOD heptavalent antitoxin for (Serotypes A-G) (IND): equine desiccated 1 vial (10 mL) IV CDC Trivalent equine antitoxin for Serotypes A, B, E (licensed)
Staphylococcal enterotoxin B	30 ng/person (incapacitating); 1.7 µg/person (lethal)	1-6 h	Nasal swab, serum, urine (BSL-2)	Ag-ELISA Serology: Ab-ELISA	Standard precautions	Ventilatory support and supportive care

*Information on diagnostics, medical management, and vaccines is available by contacting Commander, USAMRIID, at 301-619-2833 (phone) or 301-619-4625 (fax). Readers are advised to consult product literature before administering drugs or vaccines. BSL indicates biosafety level; Rx, chemotherapy; Px, chemoprophylaxis; Ag, antigen; ELISA, enzyme-linked immunosorbent assay; IV, intravenously; q, every; IM, intramuscular; qd, each day; bid, twice a day; PO, by mouth; IFA, immunofluorescent assay; IND, Investigational New Drug; SC, subcutaneous; EM, electron microscopy; PCR, polymerase chain reaction; VIG, vaccinia immune globulin; DOD, Department of Defense; VEE, Venezuelan equine encephalitis; EEE, eastern equine encephalitis; WEE, western equine encephalitis; NA, not available; RVF, Rift Valley fever; KHF, Korean hemorrhagic fever; YF, yellow fever; RT-PCR, reverse transcriptase polymerase chain reaction; Ab, antibody; CCHF, Congo-Crimean hemorrhagic fever; AHF, Argentine hemorrhagic fever; BHF, Bolivian hemorrhagic fever; CDC, Centers for Disease Control and Prevention.

fied to generate the smaller particle size. The aerosol could be delivered from a line source, such as an airplane or boat, traveling upwind of the intended target or from a point source, such as a stationary sprayer or missile bomblets, containing agent in an area upwind of the target. The meteorological conditions in the target area are very important in the

use of BW agents as aerosols because higher wind speeds and turbulence tend to break up the aerosol cloud. Other possible routes of exposure for BW agents include oral, by intentional contamination of food and water, and percutaneous. In general, these other routes of exposure are considered less important than the respiratory route in

the context of strategic use of BW agents. However, terrorists may not be constrained by either the agent characteristics or the route of exposure required on the biological battlefield.

Diseases produced by the offensive use of biological agents against military forces or civilians could be disabling or lethal. Because biological agents, inca-

Chemoprophylaxis (Px)	Vaccine Availability	Comments
Ciprofloxacin 500 mg PO bid×4 wk If unvaccinated, begin initial doses of vaccine Doxycycline 100 mg PO bid×4 wk plus vaccination	Michigan Biological Products Institute vaccine (licensed): 0.5 mL SC at 0, 2, 4 wk and 6, 12, 18 mo, then annual boosters	Vaccine: boost at-risk annually Alternates for Rx: gentamicin, erythromycin, and chloramphenicol
Doxycycline and rifampin for 3 wk in inadvertently inoculated persons	No vaccine available for human use	Trimethoprim-sulfamethoxazole may be substituted for rifampin; however, relapse rate with this drug may be up to 30%
Tetracycline 500 mg PO qid×7 d Doxycycline 100 mg PO q 12 h×7 d	Greer inactivated vaccine (licensed): 1.0 mL, then 0.2 mL boost at 1-3 and 3-6 mo	Boost at-risk 12, 18 mo & yearly. Plague vaccine not protective against aerosol in animal studies Alternate Rx: chloramphenicol or trimethoprim-sulfamethoxazole Rx: chloramphenicol for plague meningitis
Tetracycline start 8-12 d postexposure ×5 d Doxycycline start 8-12 d postexposure ×5 d	IND 610-inactivated whole cell vaccine given as single 0.5 mL SC	Recommend skin test before vaccination
Doxycycline 100 mg PO q 12 h×14 d Tetracycline 2 g/d PO×14 d	Live attenuated vaccine (IND): scarification	Culture difficult and potentially dangerous
Vaccinia immune globulin 0.6 mL/kg IM (within 3 d of exposure; best within 24 h)	Wyeth calf lymph vaccinia vaccine (licensed) DOD cell-culture derived vaccinia vaccine (IND): scarification	Preexposure and postexposure vaccination recommended if >3 y since last vaccination
NA	VEE DOD TC-83 live attenuated vaccine (IND): 0.5 mL SC×1 dose VEE DOD C-84 (formalin inactivated TC-83)(IND): 0.5 mL SC for up to 3 doses EEE inactivated (IND): 0.5 mL SC at 0 & 28 d WEE inactivated (IND): 0.5 mL SC at 0, 7, and 28 d	TC-83 reactogenic in 20% No seroconversion in 20% Only effective against subtypes 1A, 1B, and 1C Vaccine used for nonresponders to TC-83 EEE and WEE inactivated vaccines are poorly immunogenic, and multiple immunizations are required
NA	AHF Candid #1 vaccine (x-protection for BHF)(IND) RVF inactivated vaccine (IND)	Aggressive management of secondary infections and hypotension is important
NA	DOD pentavalent Toxoid for serotypes A-E (IND): SC at 0, 2, & 12 wk, then yearly boosters	Skin testing for hypersensitivity before equine antitoxin administration Ventilatory assistance
NA	No vaccine available	Vomiting and diarrhea may occur if toxin is swallowed

pacitating or lethal, produce a more prolonged period of illness than chemical agents, the impact on the health care infrastructure could be enormous. Person-to-person spread could be important for some agents, and local disease cycles might occur if a competent vector for a bacterium or virus is present in the environment. The following is an overview of several BW threat agents, the disease syndromes resulting from exposure to

them, and medical countermeasures available to clinicians (see Table).

ANTHRAX

History and Significance

Anthrax is caused by *B anthracis*, a gram-positive, sporulating bacillus. The reservoir of *B anthracis* is the soil; the organism is distributed worldwide.^{2,3} The organism exists in the infected host

as the vegetative bacillus and in the environment as a spore. Spores do not form in the infected host unless the body tissues are exposed to air. Anthrax spores can survive adverse environmental conditions and can remain viable for decades. The spore is the stage of the bacterial life cycle that is the usual infective form. Animals contract spores while grazing. Susceptible animals include cattle, sheep, goats, and horses, but other animals may develop infection. Humans contract anthrax via inoculation of minor skin lesions with spores from contact with infected animals, their hides, wool, or other products, from ingesting contaminated meat, from inhaling spores during the processing of wool for textiles, or possibly from biting flies.³

Anthrax spores were weaponized by the United States in the 1950s and 1960s before the US offensive program was terminated. Iraq admitted to a United Nations inspection team in August 1991 that it had conducted research on the offensive use of *B anthracis* before the Persian Gulf War and, in 1995, admitted to "weaponizing" anthrax. Other countries have also been suspected of weaponizing anthrax spores. The deaths of at least 66 people after an accidental release of anthrax spores in the former Soviet Union underscores the weapons potential of this agent.⁴

Clinical Features

Anthrax has 3 clinical presentations in humans: cutaneous, gastrointestinal, and inhalational.^{3,5,6} A biological attack with anthrax spores would most likely occur by aerosol delivery and would result in inhalational anthrax. This illness, known as woolsorter's disease, occurs in the textile and tanning industries among workers handling contaminated wool, hair, and hides.⁷ After being inhaled and deposited in the lower respiratory tract, spores are phagocytized by tissue macrophages and transported to hilar and mediastinal lymph nodes. The spores germinate into vegetative bacilli, producing a necrotizing hemorrhagic mediastinitis.⁵⁻⁸

Inhalation anthrax begins with a prodrome featuring fever, malaise, and fatigue. A nonproductive cough and vague chest discomfort may be present. This prodrome may be followed by symptomatic improvement for 2 to 3 days or may progress directly to the abrupt onset of severe respiratory distress with dyspnea, stridor, diaphoresis, and cyanosis. Bacteremia, septic shock, metastatic infection (meningitis in approximately half of cases), and death usually follow within 24 to 36 hours.^{6,7} Once symptoms of inhalational anthrax appear, treat-

ment is almost invariably ineffective, although there are anecdotal reports of patients surviving after early, aggressive therapy.^{6,7}

Diagnosis and Management

Physical findings are usually nonspecific. The chest x-ray film is typically without infiltrates but may reveal a widened mediastinum with pleural effusions, which may be hemorrhagic. Meningitis, often hemorrhagic, has been reported in up to 50% of cases.^{8,9} *Bacillus anthracis* can be visualized by Wright or Gram stain of peripheral blood and isolated by blood cultures but often not until late in the disease course. Vegetative bacilli are present during infection and sporulation does not occur in vivo. Animal studies of inhalational anthrax demonstrate that bacilli and toxin appear in the blood late on day 2 or early on day 3 after aerosol challenge. Toxin levels parallel the development of bacteremia. An enzyme-linked immunosorbent assay (ELISA) to detect circulating toxin is available for rapid diagnosis.

Historically, penicillin has been the treatment of choice for inhalational anthrax, with 2 million units given intravenously every 2 hours. Some animal studies suggest that addition of streptomycin may have additional benefit. All naturally occurring strains tested to date have been sensitive to erythromycin, chloramphenicol, gentamicin, and ciprofloxacin. In the absence of antibiotic sensitivity data, treatment should be instituted at the earliest signs of disease with intravenous ciprofloxacin (400 mg every 8-12 hours). Supportive therapy for shock, fluid volume deficit, and adequacy of airway may be indicated.

A licensed vaccine, an aluminum hydroxide-adsorbed preparation, is derived from culture fluid supernatant taken from an attenuated strain.³ The vaccination series consists of 6 subcutaneous doses at 0, 2, and 4 weeks, then at 6, 12, and 18 months, followed by annual boosters. There are insufficient data regarding efficacy against inhalational anthrax in humans, although studies in rhesus monkeys indicate it is protective. If there is information indicating that a BW attack is imminent or may have occurred, prophylaxis of unimmunized individuals with ciprofloxacin (500 mg by mouth twice a day), or doxycycline (100 mg by mouth twice a day) is recommended.⁹ The vaccination series should be initiated for unimmunized individuals. Should an anthrax attack be confirmed, chemoprophylaxis should be continued for at least 4 weeks and until at least 3 doses of vaccine have been received by all those exposed.

BRUCELLOSIS

History and Significance

Brucellae are small, slow-growing, pleomorphic, gram-negative aerobic nontoxigenic, non-spore-forming coccobacilli. Although the 6 species of *Brucella* are closely related,¹⁰ they each characteristically infect different animal hosts, in which they usually cause infertility or abortion. Of the 4 species pathogenic for humans, *Brucella melitensis* usually infects goats, *Brucella suis* infects swine, *Brucella abortus* infects cattle, and *Brucella canis* infects dogs. A pattern of disease severity in humans is as follows: *B melitensis* > *B suis* > *B abortus* > *B canis*. Most human infections occur by contact with infected animal tissues or ingestion of contaminated raw meat or dairy products. Person-to-person transmission typically does not occur. The bacteria are highly infectious by aerosol and commonly cause infections in laboratory workers.¹¹ Brucellae are susceptible to commonly used disinfectants and heat but may survive for 6 weeks in dust and 10 weeks in soil or water.

The United States weaponized *B suis* in the 1940s and 1950s but stopped offensive work on the agent in the 1960s. Other countries have or are suspected to have weaponized brucellae.¹² The organism could be delivered as a slurry in bomblets or, theoretically, as a dry aerosol.

Clinical Features

Brucellae are facultative intracellular macrophage parasites, and localize in organs (especially the lung, spleen, liver, central nervous system, bone marrow, and synovium) with large numbers of macrophages.¹³ Disease manifestations reflect this distribution. Symptoms and signs are similar in patients with presumed oral, aerosol, or percutaneous infection. Patients usually have fever, chills, and malaise.^{14,15} Respiratory symptoms (cough, pleuritic chest pain) may occur in 20% of patients but do not usually denote pneumonia. Sacroiliitis, large joint infections, and vertebral osteomyelitis are the most common osteoarticular manifestations.¹⁶⁻¹⁸ Genitourinary infections and hepatitis may also occur.¹⁹ Endocarditis and central nervous system infections are rare, but account for nearly all fatalities, which occur in less than 5% of untreated patients.²⁰ Systemic symptoms may last for weeks or months. Even without antibiotics, most patients recover within a year, but relapses are common.²¹ Hematological abnormalities, including anemia, neutropenia, and thrombocytopenia, may be present.²²

Diagnosis and Management

Symptoms and signs of brucellosis are nonspecific. A serum tube agglutination test is the usual diagnostic method.²³ Cultures of blood, bone marrow, and focal sites of infection may be positive.²⁴ The organism grows slowly, but adequately, in conventional blood culture bottles. Cultures must be kept for at least 6 weeks with periodic blind subculturing onto enriched agar plates. A special biphasic culture technique (Castaneda bottle), if available, may facilitate *Brucella* isolation.²⁵

Patients should be treated with combinations of antibiotics, as treatment with single agents leads to poor response or relapse. A combination of 200 mg/d of doxycycline orally and 600 to 900 mg/d of rifampin orally for 6 weeks is usually the treatment of choice.^{26,27} Trimethoprim-sulfamethoxazole may be substituted for rifampin. For bone and joint infections, endocarditis, and central nervous system disease, streptomycin or another aminoglycoside should be included, and therapy should be prolonged. Treatment of endocarditis may require valve replacement.²⁸ There is no approved *Brucella* vaccine for humans.

PLAGUE

History and Significance

Yersinia pestis, the etiologic agent of plague, is a gram-negative bacillus of the family Enterobacteriaceae that is maintained in numerous and diverse rodent reservoirs.^{29,30} Plague is transmitted via flea vectors from rodents to humans and by respiratory droplets from animals to humans or humans to humans.^{29,32}

During World War II, Japan investigated the use of plague as a biological weapon. The United States studied *Y pestis* as a potential BW agent in the 1950s before the offensive BW program was terminated, and other countries have been suspected of weaponizing plague.

Clinical Features

The clinical presentations of plague are bubonic, primary septicemic, and pneumonic disease.^{29,31} The most likely clinical presentation after a BW attack would be primary pneumonic plague.^{29,30} After an incubation period of 2 to 3 days, patients present with pneumonia featuring the acute and often fulminant onset of malaise, high fever, chills, headache, myalgia, cough with production of a bloody sputum, and clinical sepsis. The chest x-ray film reveals a patchy or consolidated bronchopneumonia. Pneumonic plague progresses rapidly, resulting in dyspnea, stridor, and cyanosis. The terminal course may feature respiratory failure, shock, and ecchymoses.

Diagnosis and Management

A presumptive diagnosis can be made by identifying a gram-negative coccobacillus and safety-pin bipolar staining organisms in gram-stained or Wright-Giemsa-stained smears from peripheral blood, lymph node needle aspirate, sputum, or other clinical specimens. Immunofluorescent staining for the capsule is diagnostic. The diagnosis can be confirmed by culturing the organism from blood, sputum, and bubo aspirates. The organism grows slowly at standard incubation temperatures and may be misidentified by automated systems because of delayed biochemical reactions. Most strains of *Y pestis* produce F1 capsule antigen in vivo, which can be detected in serum samples by immunoassay. A 4-fold rise in antibody titer is also diagnostic.

Streptomycin sulfate, tetracycline, chloramphenicol, and gentamicin sulfate are effective therapies for bubonic plague, especially if begun within 24 hours of the onset of symptoms.³⁰ Plague pneumonia is almost always fatal if treatment is not initiated within 24 hours of the onset of symptoms. Streptomycin is given intramuscularly in a dose of 30 mg/kg per day in 2 divided doses for 10 days. Gentamicin may be substituted for streptomycin. Chloramphenicol given intravenously is indicated for treating plague meningitis and in cases of circulatory compromise. Intravenous doxycycline (200 mg initially, followed by 100 mg every 12 hours) for 10 to 14 days is also effective. Results obtained from an animal model suggest that quinolones may be effective for treating plague, but they have not been evaluated in humans.³² Supportive therapy includes intravenous crystalloids and hemodynamic monitoring.

A licensed, killed whole-cell vaccine is available for use in those considered to be at risk of exposure.³³ While epidemiologic evidence supports the efficacy of the current vaccine against bubonic plague, its efficacy against aerosolized *Y pestis* is believed to be poor.³⁴

Q FEVER

History and Significance

Q fever, a febrile, zoonotic disease with a worldwide distribution, typically results from exposure to domestic livestock animals (mainly sheep, cattle, and goats). The infection is caused by *Coxiella burnetii*, an obligate intracellular rickettsialike organism of low virulence but remarkable infectivity.³⁵

Coxiella burnetii produces a sporelike form that may cause infection after indirect exposure to infected animals or animal products, such as can occur in individuals who live or work in the vicinity of infected animals.³⁶⁻³⁸ In addition, the

ability of this sporelike form to withstand heat and drying and to survive on inanimate surfaces allows the organism to persist in the environment for weeks or months after an infected animal has vacated an area and for dissemination by wind with induction of infection at sites miles distant from a source.³⁸

Individuals are at risk for acquisition of Q fever, both in the United States and abroad.^{39,40} Q fever is currently recognized as a potential BW agent, with a degree of infectivity and casualty production rivalling that of anthrax.¹ *Coxiella burnetii* was studied as a BW agent before the US BW program ended.⁴¹

Clinical Features

There is no single syndrome characteristic for acute Q fever, and the infection may be manifested by asymptomatic seroconversion in up to 50% of infections.³⁶⁻⁴⁴ The onset of Q fever may be abrupt or insidious, with fever, chills, and headache being the most common symptoms. Diaphoresis, malaise, fatigue, anorexia, and weight loss are also common. Myalgia is a frequent complaint, while arthralgia is less common. Cough tends to appear somewhat late in the illness and may not be a prominent complaint. Chest pain occurs in a minority of patients and may be pleuritic or a vague substernal discomfort. Although nonspecific evanescent skin eruptions have been reported, there is no characteristic rash. Temperature tends to fluctuate, with peaks of 39.4°C to 40.6°C, and approximately 25% of the cases are biphasic. In two thirds of patients with acute disease, the febrile period lasts 13 days or fewer.⁴³ Neurological symptoms are not uncommon and have been observed in up to 23% of acute cases.⁴⁴

Rales are the most common physical finding; evidence of pleural effusion (including friction rub) and consolidation may also be noted. Although hepatomegaly, splenomegaly, and jaundice have all been reported, they are relatively unusual in acute infection. Reports of abnormalities on chest radiograph vary with locale, but can be identified in 50% to 60% of symptomatic patients and may persist for several months.³⁸ An abnormal chest radiograph may be seen in the absence of pulmonary symptoms, while a normal chest radiograph may be observed in a patient with pulmonary symptoms.³⁸

Laboratory abnormalities associated with acute Q fever usually involve liver function tests, and patients may present with a clinical and laboratory picture consistent with acute hepatitis. Twofold and 3-fold elevations of aspartate aminotransferase and/or alanine aminotransferase are observed in 50% to 75% of patients,

while elevations of the alkaline phosphatase and/or total bilirubin are observed in only 10% to 15%.³⁸ The white blood cell count is usually normal; mild anemia or thrombocytopenia may also be observed.

The case-fatality rate of acute Q fever is low, even without treatment, and chronic disease, usually manifested by endocarditis, probably develops in less than 1% of acute infections.^{38,45} Malaise and easy fatigability lasting for months after acute infection have been reported in up to 32% of patients.³⁸

Diagnosis and Management

Diagnosis of Q fever is usually accomplished by serological testing; the most common methods are antibody detection by indirect fluorescent antibody (IFA) or ELISA. Significant antibody titers are not consistently identifiable until 2 to 3 weeks into the illness. Convalescent antibody titers, 2 to 3 months after onset of illness, typically demonstrate a 4-fold increase.^{46,47} After acute infection, significantly elevated antibody titers may persist for years.⁴⁸ Chronic infection almost always induces significant antibody titers.⁴⁵

Treatment of acute Q fever shortens the course of the disease and prevents disease when administered during the incubation period.⁴⁸ Tetracyclines remain the mainstay of therapy for acute disease. Macrolide antibiotics, such as erythromycin and azithromycin, are also effective. Quinolones, chloramphenicol, and trimethoprim-sulfamethoxazole have also been used to treat Q fever, but clinical experience with these antibiotics is limited.

Although an effective vaccine (Q-Vax) is licensed in Australia, all Q fever vaccines used in the United States are investigational.^{49,50} Individuals already immune to Q fever frequently develop severe local reactions at the site of vaccine injection.^{51,52} These reactions can be avoided by prior screening with an intradermal skin test to detect presensitized or immune individuals.⁵³

TULAREMIA

History and Significance

Francisella tularensis, the etiologic agent of tularemia, is a small, nonmotile, aerobic, facultative intracellular gram-negative coccobacillus. Tularemia (also known as rabbit fever and deer fly fever) is a zoonotic disease, and humans acquire the disease under natural conditions through inoculation of skin or mucous membranes with blood or tissue fluids of infected animals or bites of infected deerflies, mosquitoes, or ticks. Although less common, inhaling contaminated dusts or ingesting contaminated foods or water may also produce clinical dis-

ease.^{54,55} Respiratory exposure by aerosol would cause typhoidal tularemia, which often has a pneumonic component. The organism can remain viable for weeks in water, soil, carcasses, and hides, and for years in frozen rabbit meat.⁵⁵

Francisella tularensis was weaponized by the United States in the 1950s and 1960s before the US offensive BW program was terminated, and other countries may have weaponized this agent for delivery by aerosol.

Clinical Features

Tularemia may appear in 2 forms in humans depending on the route of inoculation: ulceroglandular or typhoidal. In humans, as few as 10 to 50 organisms will cause disease if inhaled or injected intradermally. The most common ulceroglandular form is usually acquired through inoculation of the skin or mucous membranes with blood or tissue fluids of infected animals. The typhoidal form, which occurs mainly after inhalation of infectious aerosols, accounts for 15% to 25% of naturally occurring cases. Typhoidal or septicemic tularemia manifests as fever, prostration, and weight loss, but without adenopathy.⁵⁵⁻⁵⁷ Respiratory symptoms of substernal discomfort and a nonproductive cough may also be present. Radiological evidence of pneumonia, with associated pleural effusion in some cases, may be present in all forms of tularemia, but is most common with typhoidal disease. The case-fatality rate with all forms of untreated typhoidal disease is approximately 35%.^{54,55}

Diagnosis and Management

Diagnosis can be established by isolating the organism from blood, sputum, skin, or mucosal membrane lesions, but it is difficult due to unusual growth requirements and/or overgrowth of commensal bacteria. Diagnosis of primary typhoidal tularemia is also difficult because signs and symptoms are nonspecific and frequently there is no suggestive exposure history. The diagnosis can best be established retrospectively by serologic testing.^{51,52}

Streptomycin (30 mg/kg per day intramuscularly in 2 divided doses for 10-14 days) is the treatment of choice.⁵⁸ Gentamicin (3-5 mg/kg per day parenterally for 10-14 days) also is effective.^{57,59} Tetracycline and chloramphenicol are effective as well but are associated with significant relapse rates.⁵⁹ Although laboratory-related infections with this organism are common, human-to-human spread is unusual and respiratory isolation is not required. A live attenuated tularemia vaccine is available as an Investigational New Drug (IND).⁶⁰

SMALLPOX

History and Significance

After the last natural case of variola in Somalia in 1977,^{61,62} smallpox was declared eradicated in 1980 by the WHO. Natural smallpox outbreaks were contained by rapid vaccination of contacts of the index cases, facilitated by the ease of vaccinia administration. There is no animal reservoir for variola; however, monkeys are susceptible to infection.⁶³ Although a laboratory accident⁶⁴ prompted the consolidation of variola virus stocks into 2 WHO-approved repositories at the Centers for Disease Control and Prevention (CDC) in Atlanta and at NPO (Scientific and Production Association) in the Novosibirsk region of Russia, the extent of clandestine stockpiles remains a matter of contention and concern.

The aerosol infectivity, high mortality, and stability of variola make it (and potentially monkeypox virus) a potential threat in BW and terrorism scenarios.^{1(pp69-70),65} Although some have argued that smallpox would have limited potential as a biological weapon,^{62(p1341)} the discontinuation of routine vaccination has rendered civilian and military populations more susceptible to a disease that is infectious by aerosol and infamous for its devastating morbidity and mortality. In 1970, the WHO expressed concerns that smallpox "can easily be produced in large quantities in the laboratory and freeze-dried and its virulence thus preserved for months or years."^{71(pp69-70)} The theoretical potential that genetic recombination could produce a modified animal poxvirus with enhanced virulence for humans has raised the specter that other poxviruses besides smallpox might constitute serious BW or reemergent public health problems. Mass vaccination of civilian populations is now complicated by the increasing number of immunocompromised patients (eg, those with human immunodeficiency virus infection, organ transplant, and chemotherapy).

Clinical Features

After aerosol exposure, variola travels from the upper or lower respiratory tract to regional lymph nodes where it replicates and gives rise to viremia followed soon thereafter by rash. During the prodrome before onset of pox lesions, variola virus can be recovered from the blood. The abrupt onset of clinical manifestations is marked by systemic toxicity with prominent malaise, fever, rigors, vomiting, headache, and backache; 15% of patients develop delirium. Approximately 10% of light-skinned patients exhibit an erythematous rash during this phase. Two to 3 days later, an enanthem appears concomitantly with a

discrete rash about the face, hands, and forearms. The mucous membrane lesions shed infectious oropharyngeal secretions in the first few days of the eruptive illness.⁶⁶ These respiratory secretions are the most important but not the sole means of virus transmission to contacts. After eruptions on the lower extremities, the rash spreads centrally to the trunk over the next week. Lesions quickly progress from macules to papules and eventually to pustular vesicles. Lesions are more abundant on the extremities and face, and this centrifugal distribution is an important diagnostic feature. In distinct contrast to varicella, lesions on various segments of the body remain generally synchronous in their stage of development. In the second week after onset, the pustules form scabs that leave depressed depigmented scars on healing. Although variola titers in the throat, conjunctiva, and urine diminish with time,⁶⁷ virus can readily be recovered from scabs throughout convalescence.⁶⁸ Therefore, patients should be isolated and considered infectious until all scabs separate.

In distinct contrast to varicella, lesions on various segments of the body remain synchronous in their stage of development.

During this past century, the prototypical disease variola major caused mortality of 3% and 30% in the vaccinated and unvaccinated, respectively.^{62(pp691)} Other clinical forms associated with variola major, flat-type and hemorrhagic-type smallpox, were notable for severe mortality. A naturally occurring relative of variola, monkeypox, occurs in Africa and is clinically indistinguishable from smallpox except for a notable enlargement of cervical and inguinal lymph nodes. Secondary bacterial pneumonia is associated with greater than 50% mortality.⁶⁹ Concern has been raised whether monkeypox could be weaponized like variola. Although previous evidence suggested that monkeypox had limited potential for person-to-person transmission,⁷⁰ recent reports indicate greater potential for sustained interhuman transmission,⁷¹ perhaps owing to declining vaccinia immunity of the populace.

Diagnosis and Management

Given the eradication of endemic smallpox, it requires an astute clinician to distinguish the forme fruste of this disease from other vesicular exanthems, such as chickenpox, erythema multiforme with bullae, or allergic contact dermatitis. Many exposed persons may shed virus

from the oropharynx without ever manifesting disease. Some close contacts may harbor virus in their throats without developing disease and hence may serve as a means of secondary transmission.⁷² Rapid and definitive diagnostic measures are urgently needed to provide effective quarantine and countermeasures to avert panic.

The appearance of characteristic virions on electron microscopy or Guarnieri bodies under light microscopy⁷³ is useful but does not discriminate variola from vaccinia, monkeypox, or cowpox. The traditional method of isolating virus on chorioallantoic membrane is antiquated. Polymerase chain reaction diagnostic techniques promise more accurate and less cumbersome methods of discriminating between variola and other orthopoxviruses.⁷⁴

Clinicians must be prepared to recognize a vesicular exanthem in possible BW theaters as potential variola and to initiate appropriate countermeasures. Any confirmed case of smallpox should be considered an international emergency with immediate report made to public health authorities. Strict quarantine with respiratory isolation should be applied for 17 days to all persons in direct contact with the index case, especially the unvaccinated. Immediate vaccination should be undertaken for all persons exposed to either weaponized variola virus or a clinical case of smallpox. Nosocomial transmission of variola generally requires close person-to-person proximity, but there is a potential for airborne spread.⁷⁵⁻⁷⁷ Patients with smallpox are infectious from the time of onset of their eruptive exanthem, most commonly from days 3 to 6 after onset of fever. Infectivity is markedly enhanced if the patient manifests a cough. Indirect transmission via contaminated bedding or other fomites is infrequent.⁷⁸

Although the antiviral drug methisazone was licensed for the prophylaxis of susceptible contacts of smallpox in the 1960s,⁷⁹⁻⁸² its efficacy was controversial, gastrointestinal intolerance limited its use, and it is no longer available. Although there is no chemotherapeutic agent proven effective against smallpox, cidofovir demonstrates broad in vitro and in vivo activity against Poxviridae⁸³ and might be useful as a therapeutic agent. The US Army Medical Research Institute of Infectious Diseases (USAMRIID) is evaluating classes of drugs that target 6 different functions involved in poxvirus replication. Four drugs (adefovir dipivoxil, cidofovir, cyclic cidofovir, and ribavirin) in advanced clinical testing for other viral infections showed significant in vitro antiviral activity and may be candidates for the

treatment of systemic disease from a poxvirus (J. W. Huggins, written communication, July 1997).

Of the commercial vaccines used during the WHO smallpox eradication campaign, only calf lymph vaccine (Dryvax, Wyeth) is still available in the United States. A replacement vaccine prepared in cell culture by the Department of Defense is currently an IND product. During the WHO smallpox eradication campaign,^{62(pp311-313)} vaccination with a verified clinical "take" within the past 3 years was considered solid immunity to smallpox. With longer intervals between vaccination and subsequent variola exposure, protection is reduced. Given the potential for breakthrough against partial immunity following high-dose aerosol exposure, routine revaccination of all potentially exposed individuals would seem prudent in a BW scenario. If vaccination is accomplished within a few days after exposure, protection is also possible,⁸³ approaching complete protection in those who have had their primary vaccination previously.⁸⁴

VIRAL ENCEPHALITIDES

History and Significance

Venezuelan, eastern, and western equine encephalitis viruses (VEE, EEE, and WEE, respectively) are members of the Alphavirus genus of the family Togaviridae. Several characteristics of the equine encephalitis viruses lend themselves to weaponization.⁸⁵ Although naturally transmitted by mosquitoes, the encephalitic alphaviruses are also highly infectious by aerosol.⁸⁶ These viruses can be produced in large amounts in inexpensive and unsophisticated systems and are relatively stable during storage and manipulations. Readily available strains may produce incapacitating or lethal infection. The alphaviruses are amenable to genetic manipulation by modern recombinant DNA technology. This capability may be used to develop safer and more effective vaccines.⁸⁷

VEE has 11 distinct subtypes: IA, IB, and IC subtypes are pathogenic for horses and have the capacity for explosive epizootics with epidemic human disease. The enzootic strains (subtypes ID, IE, IF, II, III, IV, V, and VI) are not virulent for equines but have transmission cycles involving rodents and *Culex* mosquitoes of the genus *Melanocnion*.⁸⁸ Both EEE and WEE viruses are classified into 2 distinct geographic complexes.

The epidemiology of the equine encephalitis in humans is closely tied to the ecology of these viruses in naturally occurring endemic foci.⁸⁹ Evidence of

widespread human VEE infections outside known endemic areas, in the absence of mosquito vectors or equine disease, should be viewed with suspicion and could indicate an unnatural release of virus into the environment.

Clinical Features

The 3 equine encephalitis virus complexes within the *Alphavirus* genus are recognized for their potential for neuroinvasion and encephalitis in humans, sometimes in epidemic proportions. However, the majority of infections caused by these viruses are manifested as systemic, viral febrile syndromes consisting of fever, headache, and myalgia. Therefore, in a potential BW scenario, alphaviruses should be considered in the differential diagnosis whenever epidemic febrile illness occurs, especially with progression to neurological disease. Sick or dying equines in the vicinity of an epidemic febrile disease should also suggest the possibility of large-scale alphavirus exposure. These alphaviruses vary markedly in their neurological sequelae. Depending on the virus producing it, the general syndrome of alphavirus encephalitis presents with a varying combination of fever, headache, confusion, obtundation, dysphasia, seizures, paresis, ataxia, myoclonus, and/or cranial nerve palsies.

An important characteristic of VEE as a biological warfare weapon is that essentially all human infections are symptomatic.⁹⁰ Both epizootic and enzootic VEE strains cause similar disease syndromes. Patients develop a prostrating syndrome of chills, high fever (38°C to 40.5°C), headache, and malaise. Photophobia, sore throat, myalgia, and vomiting also are common symptoms. However, only a small percentage of VEE infections progress to neurological involvement (0.5% to 4%).⁹¹ For those who survive encephalitic involvement of VEE, neurological recovery is usually complete.⁹²

Clinical presentation of EEE and WEE infection is similar. Adults typically exhibit a febrile prodrome for up to 11 days before the onset of neurological disease.⁹³ Symptoms usually begin with malaise, headache, and fever, followed by nausea and vomiting. Viremia is detectable during this febrile prodrome.⁹⁴ Over the next few days, the symptoms intensify as somnolence or delirium may progress into coma. The magnitude of morbidity and mortality from aerosol exposure is unknown.

For all 3 equine encephalitis viruses, patients demonstrate leukopenia early during the course of their febrile illness, followed later by a leukocytosis. Elevated serum aspartate aminotransferase levels are common in VEE infections. For those

patients with central nervous system involvement, a lymphocytic pleocytosis with a cell count of up to $500 \times 10^6/L$ will be observed in the cerebrospinal fluid (CSF). Patients with EEE commonly have an elevated opening pressure following lumbar puncture, and in children especially, the CSF pleocytosis may reach a cell count of $2 \times 10^6/L$.⁹⁵

Of the arboviral encephalitides, EEE is the most severe. High mortality rates and severe neurological sequelae are seen among patients with EEE infection.⁹⁶ Case-fatality rates are estimated at 50% to 75%, but asymptomatic infections and milder clinical illness are certainly underreported.⁹⁷ Up to 30% of survivors are left with neurological sequelae, such as seizures, spastic paralysis, and cranial neuropathies. Like VEE, WEE is less virulent for adult humans than it is for equines and children, with lower rates of fatalities and neurological sequelae.⁹⁸ As with EEE, infants and the elderly with WEE are especially susceptible to severe clinical illness and neurological sequelae, with case-fatality rates of about 10%. Some patients are left with permanent residua of motor weakness, cognitive deficits, or a seizure disorder, with children having a higher incidence of neurologic sequelae in inverse proportion to their age.

Diagnosis and Management

Specific diagnosis of alphavirus encephalitis can be accomplished by virus isolation or serologic testing.⁹⁹ During the first few days of symptoms of non-specific febrile illness, virus may be recovered from a patient's serum.¹⁰⁰ Isolates of VEE and WEE virus also have been recovered from throat washes of acutely ill patients. Although viremia is rarely detectable by the time patients present with encephalitic symptoms,¹⁰¹ hemagglutination-inhibiting, ELISA, or plaque-reduction neutralization antibodies are generally present by the second week of illness.¹⁰² In acute phase serum samples, IgM antibodies are present.¹⁰³ Identifying the VEE subtype of an isolate involved can be accomplished by cross neutralization tests or nucleotide sequence analysis. Four-fold titer rises in convalescent serum samples or isolation of virus are considered diagnostic, but because of serological cross reactions with other alphaviruses, neutralization tests are preferred. Virus may occasionally be isolated from CSF in encephalitis cases and is frequently recovered from postmortem brain tissue of infected patients.

No specific therapy exists for the alphavirus encephalitides, and hence treatment is aimed at management of specific symptoms (eg, anticonvulsant

medication or protection of the airway). A special problem occasionally seen among patients infected by WEE virus is an extremely high fever, which may require aggressive antihyperthermia measures. Observations of both humans¹⁰⁴ and animals indicate that treatment with virus-neutralizing antisera fails to halt progression of disease if brain infection is firmly established. Defense against alphavirus infection, beyond respiratory protection with a high-efficiency particle filter, depends on immunization. Although the requisites for protection against parenteral infection with equine encephalitis viruses are well described,^{105,106} the requirements for protection against infectious aerosols as would be encountered in a BW scenario are certainly more stringent. Although immunity to the homologous serotype after VEE infection is probably lifelong, cross-immunity to heterologous serotypes is weak or nonexistent, and adequate immunization may require polyvalent vaccines. A live attenuated vaccine for VEE (TC-83) has largely eliminated homologous VEE strain infections among at-risk laboratory personnel.¹⁰⁷ However, the TC-83 vaccine is reactogenic, as more than 20% of vaccine recipients experience fever, malaise, and headache after vaccination, with half of these severe enough to warrant bed rest for 1 to 2 days. Investigational formalin-inactivated vaccines for humans exist for VEE, WEE, and EEE but require multiple injections and are poorly immunogenic. In view of these shortcomings, live attenuated, genetically engineered vaccines have been developed by site-directed mutagenesis of various alphaviruses and show excellent promise with regards to safety and immunogenicity.⁸⁷

VIRAL HEMORRHAGIC FEVERS

History and Significance

The viral hemorrhagic fever (VHF) syndrome is a useful clinical concept that describes the disease processes associated with infection by a variety of RNA viruses. Viral hemorrhagic fever syndrome is an acute febrile illness characterized by malaise, prostration, generalized signs of vascular permeability, and abnormalities of circulatory regulation. Life-threatening loss of blood volume is rare, although bleeding manifestations often occur as a result of damage to the vascular endothelium. Despite their diverse taxonomy, the VHF agents are all RNA viruses and are typically transmitted to humans by contact with infected animal reservoirs or arthropod vectors whose distributions determine in part the geographic ranges of these diseases. Recent changes in human de-

mographics have increased human exposures to these viruses. In addition to natural disease potential, many of the VHF agents are potential BW threats as well. These viruses are highly infectious by aerosol; are associated with high morbidity and, in some cases, high mortality; and may replicate sufficiently well in cell culture to permit weaponization.

Viruses from the Arenaviridae, Bunyaviridae, Filoviridae, and Flaviviridae families are associated with VHF. The Arenaviridae includes the viruses of Lassa fever (Lassa virus),¹⁰⁸ and Argentine, Bolivian, Venezuelan, and Brazilian hemorrhagic fevers (Junin,¹⁰⁹ Machupo,¹¹⁰ Guanarito,¹¹¹ and Sabia¹¹² viruses, respectively). Among the Bunyaviridae, the significant human pathogens include Rift Valley fever (RVF) virus, causative agent of a major disease in Africa frequently associated with unusual increases in mosquito populations.¹¹³ Congo-Crimean hemorrhagic fever (CCHF) virus is carried by ticks and has been associated with sporadic, yet particularly severe VHF in Europe, Africa, and Asia.¹¹⁴ It has frequently been associated with small, hospital-centered outbreaks. Hantaviruses, unlike other Bunyaviridae, are not transmitted by infected arthropods; rather, they infect humans by contact with infected rodents and their excreta. Hantaviruses are significant infectious disease threats to both military and civilian populations.^{115,116} However, hantaviruses replicate poorly in cell culture and are not considered to be significant BW threats; thus, they are not discussed further here.

Another VHF group with biological warfare potential is the Filoviridae, which includes the agents of Ebola hemorrhagic fever and Marburg disease. Filoviruses have gained notoriety through their association with explosive, although limited, outbreaks. The original Marburg virus outbreak in 1967 was associated with 31 cases and 9 deaths.¹¹⁷ Ebola was first recognized in association with 2 explosive outbreaks that occurred almost simultaneously in 1976. The original outbreaks of Ebola in Zaire¹¹⁸ and Sudan¹¹⁹ in 1976 were associated with mortality rates of 92% and 53%, respectively. In both cases, transmission was exacerbated through reuse of unsterilized needles and syringes and nosocomial contacts.

Yellow fever is another VHF virus.¹²⁰ Despite its high aerosol infectivity, widespread use and availability of licensed vaccines limit the concern regarding its potential as a BW threat.

Clinical Features

The dominant clinical features of VHF are usually a consequence of microvas-

cular damage and changes in vascular permeability.¹²¹ Common presenting complaints are fever, myalgia, and prostration. Initial clinical examination may reveal only conjunctival injection, mild hypotension, flushing, and petechial hemorrhages. Full-blown VHF typically evolves to shock and generalized mucous membrane hemorrhage and often is accompanied by evidence of neurological, hematopoietic, or pulmonary involvement. Hepatic involvement is common, but clinical jaundice is a regular event only with yellow fever. Renal failure is proportional to cardiovascular compromise.¹²¹

Although all VHF cases share common features, certain clinical characteristics predominate and serve to distinguish among the causative agents. For example, hemorrhagic manifestations are not pronounced for Lassa fever patients, and neurological complications are infrequent. For the South American arenaviruses (Junin and Machupo), neurological and hemorrhagic manifestations are much more prominent. For RVF, hemorrhagic fever is seen in only a small proportion of the cases, as this virus is primarily hepatotropic. Unlike other VHFs, retinitis is a frequently reported component of RVF disease.¹²¹ In contrast, hemorrhagic manifestations are predominant with CCHF infection, which causes a profound disseminated intravascular coagulation (DIC). Marburg and Ebola viruses produce prominent maculopapular rashes, and DIC is a major factor in their pathogenesis.

Diagnosis and Management

Viral hemorrhagic fever should be suspected in any patient presenting with a severe febrile illness and evidence of vascular involvement who has traveled to an area where the virus is known to occur or when a BW threat is suspected.

Definitive diagnosis in an individual case requires specific virologic diagnosis.¹²² Most patients will present with viremia that can be detected by antigen-capture ELISA or reverse transcriptase polymerase chain reaction (RT-PCR). Likewise, early IgM antibody responses to these agents can be detected by ELISA, often during the acute illness. Definitive virus isolation takes longer and requires specialized analysis in a biocontainment laboratory (BSL 3 or BSL 4). When the identity of the VHF agent is totally unknown, isolation in cell culture and direct visualization by electron microscopy, followed by immunological identification by immunohistological techniques is often successful. Immunohistological techniques are also useful for retrospective diagnosis of formalin-fixed tissues.

Patients with VHF generally benefit from rapid, nontraumatic hospitalization to prevent unnecessary damage to the fragile capillary bed. Secondary infections are common and should be sought and treated aggressively. Intravenous lines, catheters, and other invasive techniques should be avoided unless clearly indicated in management. The management of bleeding is controversial. In the absence of definitive evidence, it is recommended that mild bleeding manifestations not be treated at all.¹²¹ More severe hemorrhage indicates a need for appropriate replacement therapy. When definite laboratory evidence of DIC develops, heparin therapy should be used if appropriate laboratory control is available.

Management of hypotension and shock is difficult. Patients often are modestly dehydrated, and there are covert losses of intravascular volume through hemorrhage and increased vascular permeability. Nevertheless, these patients often respond poorly to fluid infusions and readily develop pulmonary edema. The diffuse nature of the vascular process may lead to a requirement for support of several organ systems.

Ribavirin, a nonimmunosuppressive nucleoside analog with broad antiviral properties,¹²³ is of proven value for some of the VHF agents. Ribavirin has been shown to reduce mortality from Lassa fever in high-risk patients¹²⁴⁻¹²⁶ and presumably decreases morbidity in all Lassa patients. Treatment is most effective if begun within 7 days of onset. In Argentina, ribavirin has been shown to reduce virologic parameters of Junin infection and is now used routinely as an adjunct to immune plasma.¹²⁷ Small studies of ribavirin in treatment of Bolivian hemorrhagic fever (BHF) and CCHF have been promising, as have preclinical studies for RVF.¹²⁸ Conversely, preclinical studies predict ribavirin will be ineffective against both the filoviruses and the flaviviruses. No other antiviral compounds are currently available for these infections.

Argentine hemorrhagic fever (AHF) responds to therapy with 2 or more units of convalescent plasma containing adequate amounts of neutralizing antibody provided treatment is initiated within 8 days of onset.¹²⁹ Antibody therapy is also beneficial for treating BHF. Efficacy of immune plasma in treatment of Lassa fever¹²⁹ and CCHF¹³⁰ is limited by low neutralizing antibody titers and the consequent need for careful donor selection. Equine immune globulin against Ebola virus has been proposed for treating this infection, but data obtained from experimentally infected monkeys do not support this recommendation.¹³¹

A licensed and highly efficacious vaccine for yellow fever is widely available. For AHF, a live attenuated Junin vaccine strain is available as an IND. This vaccine may also provide some cross-protection against BHF. Two IND vaccines for RVF were developed by researchers at USAMRIID: an inactivated vaccine that requires 3 boosters has been in use for 20 years and a live attenuated RVF strain (MP-12) is now in phase 2 efficacy testing.

BOTULINUM TOXINS

History and Significance

Botulinum toxins are proteins of approximately 150 000 molecular weight and are produced by the anaerobic bacterium *Clostridium botulinum*. There are 7 distinct but related neurotoxins, A through G, produced by different strains of the clostridial bacillus. All 7 types act by a similar mechanism and induce similar effects when inhaled or ingested. Botulinum toxins have caused numerous cases of botulism when improperly prepared or canned foods are ingested. Many deaths have occurred after such incidents. It is feasible to deliver botulinum toxins as a biological weapon, and several countries have weaponized or are suspected to have weaponized 1 or more of this group of toxins.¹³² Iraq admitted to a United Nations inspection team in August 1991 that it had performed research on the offensive use of botulinum toxins before the Persian Gulf War. Additional information given in 1995 revealed that Iraq had not only researched but had filled and deployed over 100 munitions containing botulinum toxin. Although an aerosol attack is by far the most likely scenario for the use of botulinum toxins, theoretically, the agent could be used to sabotage food supplies.

Clinical Features

Botulinum toxins are the most toxic compounds known, with an estimated toxic dose (serotype A) of only 0.001 µg/kg of body weight.¹³³ Botulinum toxin is 15 000 times more toxic than the nerve agent VX and 100 000 times more toxic than sarin.

Botulinum toxins act by binding to the presynaptic nerve terminal at the neuromuscular junction and at cholinergic autonomic sites.¹³⁴ The toxins then act to prevent the release of acetylcholine presynaptically, and thus block neurotransmission. This interruption of neurotransmission causes both bulbar palsies and the skeletal muscle weakness seen in clinical botulism.

The onset of signs of inhalation botulism is dose dependent and may vary from 24 to 36 hours to several days after exposure.^{135,136} Bulbar palsies are prominent early with ocular symptoms, such

as blurred vision due to mydriasis, diplopia, ptosis, and photophobia, in addition to other bulbar signs such as dysarthria, dysphonia, and dysphagia. Skeletal muscle paralysis follows, manifested as a symmetrical, descending, and progressive weakness which may culminate abruptly in respiratory failure. Progression from onset of symptoms to respiratory failure has occurred in as few as 24 hours in cases of foodborne botulism.

Physical examination usually reveals an alert and oriented patient without fever. Postural hypotension may be present. Mucous membranes may be dry and crusted, and the patient may complain of dry mouth or even sore throat. Gag reflex may be absent. Pupils may be dilated and even fixed. Ptosis and extraocular muscle palsies are commonly observed. Variable degrees of skeletal muscle weakness occur, depending on progression of intoxication in an individual patient. Deep tendon reflexes may be present or absent. With severe respiratory muscle paralysis, the patient may become cyanotic or exhibit narcosis from carbon dioxide retention.

Diagnosis and Management

The occurrence of an epidemic of cases of a descending and progressive bulbar and skeletal paralysis in afebrile patients typical of classical botulism points to the diagnosis of botulinum intoxication. Individual cases might be confused clinically with other neuromuscular disorders such as Guillain-Barré syndrome, myasthenia gravis, or tick paralysis. The edrophonium (or Tensilon) test may be transiently positive in botulism, so it may not distinguish botulinum intoxication from myasthenia.

Laboratory tests are generally of limited value in the diagnosis of botulism. Studies suggest that aerosolized toxin is usually not identifiable in serum or stool, whereas it is with foodborne botulism.¹³⁷ Survivors do not usually develop an antibody response due to the subimmunogenic amount of toxin necessary to produce clinical symptoms. Toxin may be present on nasal mucous membranes and detectable by ELISA for 24 hours after inhalation.

Respiratory failure secondary to paralysis of respiratory muscles is the most serious complication and, generally, the cause of death. With tracheostomy or endotracheal intubation and ventilatory assistance, fatalities should be less than 5%.³⁷ Intensive and prolonged nursing care may be required for recovery, which may take several weeks or even months.

Animal experiments show that after aerosol exposure, botulinum antitoxin can be very effective, precluding all signs of intoxication if given before the onset

of clinical signs.¹³⁵ Administration of antitoxin is reasonable if disease has not progressed to a stable state.

A trivalent equine antitoxin is available from the CDC for cases of foodborne botulism. Adverse effects of this antitoxin include the risks of anaphylaxis and serum sickness. A "despeciated" [F(ab')₂] equine heptavalent antitoxin (against types A through G) has been prepared by the US Army. This product is under IND status. Its efficacy in humans is not yet known.¹³⁵ Use of either antitoxin requires skin testing for horse serum sensitivity before administration.

Immunized laboratory animals are fully protected from lethal inhalation challenges with serotype A toxin (J. E. Brown, written communication, July 1997). A pentavalent toxoid of *C botulinum* toxin types A through E is available under IND status.¹³⁶(pp515-519)

STAPHYLOCOCCAL ENTEROTOXIN B

History and Significance

Staphylococcus aureus produces a number of exotoxins, one of which is SEB. The toxins are referred to as exotoxins because they are excreted from the organism; however, they normally exert their effects on the gastrointestinal tract and therefore are called enterotoxins. SEB is one of the heat-stable pyrogenic toxins that commonly causes food poisoning in humans after the toxin is produced in improperly handled foodstuffs and subsequently ingested. Because of its extreme toxicity as an incapacitant, inhalation exposure to this toxin could render a high percentage of exposed personnel clinically ill, requiring medical care beginning a few hours after exposure. SEB is relatively stable in aerosols. It causes symptoms when inhaled at very low doses in humans; an inhaled dose several logs lower than the estimated lethal dose would be sufficient to incapacitate individuals so exposed. Even though SEB is not generally thought of as a highly lethal agent, it may incapacitate humans many miles downwind from the release point of a weapon. This toxin could also be used, theoretically, in a special forces or terrorist mode to sabotage food or small volume water supplies.

Clinical Features

Inhaled SEB can induce extensive pathophysiological changes to include widespread systemic damage and even septic shock. Many of the effects of this family of toxins are mediated by interactions with the host's own immune system. The mechanisms of toxicity are complex, but are related to the toxin binding directly to the major histocompatibility

complex and subsequent stimulation of the proliferation of large numbers of T cells.¹³⁸⁻¹⁴⁰ Because these exotoxins are extremely potent activators of T cells, they are commonly referred to as bacterial superantigens. These superantigens stimulate the production and secretion of various cytokines from immune system cells.¹⁴¹ Released cytokines are thought to mediate most of the toxic effects of SEB.

Inhalation exposure is projected to cause primarily clinical illness and incapacitation; however, intoxications can be lethal. Intoxication with SEB begins 3 to 12 hours after inhalation of the toxin. Those exposed may experience the sudden onset of fever, headache, chills, myalgia, and a nonproductive cough. More severe cases may develop dyspnea and retrosternal chest pain. Nausea, vomiting, and diarrhea will also occur in many patients due to inadvertently swallowed toxin, and fluid losses can be marked. The fever may last up to 5 days and range from 39.4°C to 41.1°C, with variable degrees of chills and prostration. The cough may persist up to 4 weeks, and patients may not be able to return to normal functions for 2 weeks.

Physical examination in patients with SEB intoxication is often unremarkable. Conjunctival injection may be present, and postural hypotension may develop due to fluid losses. Chest examination is unremarkable except in the unusual case where pulmonary edema develops. The chest x-ray film is also generally normal, but in severe cases, increased interstitial markings, atelectasis, and possibly overt pulmonary edema or an adult respiratory distress syndrome may develop.

Diagnosis and Management

As is the case with botulinum toxins, intoxication caused by SEB inhalation is a clinical and epidemiologic diagnosis. Because the symptoms of SEB intoxication may be similar to the symptoms triggered by several respiratory pathogens such as influenza, adenovirus, and mycoplasma, the diagnosis may be unclear initially. All of these might present with fever, nonproductive cough, myalgia, and headache. An SEB attack would cause patients to present in large numbers over a very short period of time, probably within 24 hours, in contrast with naturally occurring pneumonias or influenza with patients presenting over a more prolonged interval. Staphylococcal food poisoning cases would not present with pulmonary symptoms. Intoxication with SEB tends to progress rapidly to a fairly stable clinical state, whereas pulmonary anthrax, tularemia pneumonia, or pneumonic plague would all progress if left untreated. Tularemia and plague, as well as Q fever, would be associated with infiltrates on

chest radiographs, unlike SEB. Nerve agent intoxication would cause fasciculations and copious secretions, and sulfur mustard would cause skin lesions in addition to pulmonary findings. The dyspnea associated with botulinum intoxication is associated with obvious signs of muscular paralysis, bulbar palsies, lack of fever, and a dry pulmonary tree due to cholinergic blockade; respiratory difficulties occur late with botulism, in contrast, they occur early with SEB inhalation.

Laboratory findings are not very helpful in the diagnosis of SEB intoxication. A nonspecific neutrophilic leukocytosis and an elevated erythrocyte sedimentation rate may be seen 12 to 24 hours after exposure, but these abnormalities are present in many illnesses. Toxin is very difficult to detect in the serum by the time symptoms occur. Data from animal studies show that SEB in the serum is transient; however, SEB or its antigenic metabolites accumulate in the urine and can be detected for several hours postexposure (C. T. Liu, USAMRIID, unpublished data, February 1995). Therefore, urine samples also should be obtained and tested. Because most patients will develop a significant antibody response to the toxin, acute and convalescent serum that may be helpful retrospectively in the diagnosis should be drawn. The toxin may be identified by ELISA in nasal swabs taken within 24 hours after aerosol exposure.

Currently, therapy is limited to supportive care. Close attention to oxygenation and hydration are important, and in severe cases with pulmonary edema, ventilation with positive end-expiratory pressure and diuretics might be necessary. The value of steroids is controversial. Most patients would be expected to recover after the initial acute phase of their illness, and most would generally be able to return to normal functions in 1 to 2 weeks.

Although there is currently no human vaccine for immunization against SEB intoxication, several vaccine candidates are in development. Preliminary animal studies have been encouraging and vaccine candidates for both SEB and staphylococcal enterotoxin A, a related toxin, are nearing safety and immunogenicity testing in humans.¹⁴² Experimentally, passive immunotherapy can reduce mortality in animal models, but only when given within 4 to 8 hours after inhaling SEB.¹⁴³

THE EPIDEMIOLOGY OF A BW OR TERRORIST ATTACK

Although the likelihood of a biological attack is unknown, and significant defensive preparations are underway, many believe the United States is vulnerable. This is especially true of civilian

populations, who often do not have protective equipment or vaccines made available to them. The unfortunate fact remains that humans are often the most sensitive, or the only, detector of a biological attack.¹⁴⁴ Without knowledge of the attack, an increased number of patients presenting with signs and symptoms caused by the disseminated disease agent is the most likely first indicator that a BW has occurred.

A sound epidemiologic investigation of a disease outbreak, whether natural or artificial, will assist medical personnel in identifying the pathogen, as well as instituting the appropriate medical interventions. The CDC realized this as early as 1951, when the Epidemic Intelligence Service was created to train epidemiologists in case a BW attack should take place against the United States during the cold war.¹⁴⁴ Documenting who is affected, possible routes of exposure, signs and symptoms of disease, and the rapid identification of the causative agents will greatly increase the ability to plan an appropriate medical and public health response. Good epidemiologic information will allow the appropriate follow-up of those potentially exposed, as well as help determine public information guidelines and responses to the media.

Many, if not most, diseases caused by weaponized biological agents present with nonspecific signs and symptoms that could be misinterpreted as natural occurrences. The disease pattern that develops is an important factor in differentiating between a natural and a terrorist or warfare attack. In most naturally occurring epidemics, there is a gradual rise in disease incidence, as people are progressively exposed to an increasing number of patients, vectors, or fomites that spread the pathogen. In contrast, those exposed to a BW attack would all come in contact with the agent at approximately the same time. Even taking into account varying incubation periods based on exposure dose and physiological differences, a compressed epidemic curve with a peak in a matter of days, or even hours, would occur. Most point source exposures will present in this fashion, including foodborne outbreaks, which may be natural or possibly intentionally induced. Therefore, further information should be obtained to help establish whether an outbreak is caused by an attack with a BW agent.

The general steps for epidemiologic assessment of any disease can be applied to a BW or terrorist attack.^{144, 145} First, public health authorities and health care personnel should formulate a case definition to determine the number of actual cases (verify the epidemic) and from that the approximate attack rate. Is the disease

rate greater than the background rate of disease that normally occurs? The potential exists for hysteria to be confused with actual disease; therefore, objective criteria should be used to document the number of people affected. Once a case definition has been determined, description of the epidemic can be done with respect to the timing, place, and other characteristics of those who are ill. The investigation obviously needs to be done expeditiously, but even rudimentary information can be of assistance in determining the source and potential consequences of an outbreak.

The unintended release of anthrax spores from a military compound in the former Soviet Union in 1979 demonstrated some of the epidemiologic indicators of an unnatural epidemic. The location of casualties followed a distinctive downwind pattern from the release site, animals in the same area were affected, and an unusual presentation of the disease, respiratory instead of cutaneous, occurred.¹⁴⁶ Other possible clues to a BW or terrorist attack include high disease rates among exposed individuals, more respiratory cases of disease if the agent is disseminated via aerosol, occurrence of a disease that is unusual in a given geographic area, a naturally vector-borne disease occurring in an area that lacks the appropriate vectors for normal transmission, more than 1 epidemic occurring at the same time, higher morbidity and mortality than normally expected for a disease, lower attack rates in personnel protected from exposure (such as those inside a building), and suspicious activity or discovery of a potential delivery system such as a spray device.¹⁴⁴ If an attack with biological agents is suspected, the proper authorities, whether military or civilian, should be notified immediately.

To minimize the effects of a biological terrorist attack, health care professionals and public health authorities must be aware of the threat of biological warfare and terrorism and have an increased index of suspicion that such an attack can occur. They must have some understanding of the classes of agents that have been and can be weaponized and their effects after inhalation. Surveillance of background disease activity should be ongoing, and any unusual changes in disease occurrence or etiology should be promptly followed up with a directed examination of the facts regarding the increased rates. Through close attention to disease patterns, we can become aware of a potential problem in time to institute rapid action that can potentially save many lives, and decrease the impacts of disease, regardless of its origin.

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Biological Warfare

A Historical Perspective

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The deliberate use of microorganisms and toxins as weapons has been attempted throughout history. Biological warfare has evolved from the crude use of cadavers to contaminate water supplies to the development of specialized munitions for battlefield and covert use. The modern development of biological agents as weapons has paralleled advances in basic and applied microbiology. These include the identification of virulent pathogens suitable for aerosol delivery and industrial-scale fermentation processes to produce large quantities of pathogens and toxins. The history of biological warfare is difficult to assess because of a number of confounding factors. These include difficulties in verification of alleged or attempted biological attacks, the use of allegations of biological attacks for propaganda purposes, the paucity of pertinent microbiological or epidemiologic data, and the incidence of naturally occurring endemic or epidemic diseases during hostilities. Biological warfare has been renounced by 140 nations, primarily for strategic and other pragmatic reasons. International diplomatic efforts, including the 1972 Biological Weapons Convention, have not been entirely effective in preventing the enhancement and proliferation of offensive biological warfare programs. The threats posed by biological weapons are likely to continue into the future.

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HUMANS, regrettably, have used available technologies for destructive as well as for beneficial purposes throughout history. Modern attempts to "weaponize" biological toxins such as botulinum and ricin were anticipated by the use of curare and amphibian-derived toxins as arrow poisons by aboriginal South Americans using neolithic technology. Fomites (ie, objects that harbor and can transmit disease agents) have been used to deliberately transmit infectious diseases since antiquity. The study of the history of biological warfare is confounded by several factors. These include difficulties confirming allegations of biological attack, the lack of reliable microbiological and epidemiologic data regarding alleged or attempted attacks, the use of allegations of biological attack for propaganda, and the secrecy surrounding biological weapons programs. However, a review of historical sources demon-

strates that interest in developing biological weapons has persisted throughout history and is likely to continue into the future.

EARLY ATTEMPTS

Recognition of the potential impact of infectious diseases on armies resulted in the crude use of filth, cadavers, animal carcasses, and contagion as weapons. These have been used to contaminate wells, reservoirs, and other water sources of armies and civilian populations under attack since antiquity, through the Napoleonic era, and into the 20th century.¹ The use of fomites directly against humans has continued, as evidenced by the smearing of pungi sticks with excrement by the Viet Cong in the early 1960s.²

One of the earliest recorded attempts of using fomites against a population illustrates the complex epidemiologic issues raised by biological warfare. During the 14th-century siege of Kaffa (now Feodosia, Ukraine), the attacking Tatar force experienced an epidemic of plague. The Tatars attempted to convert their misfortune into an opportunity by catapulting the cadavers of their deceased into the city to initiate a plague epidemic. An outbreak of plague was followed by the retreat of defending forces and the conquest of Kaffa. Ships carrying plague-infected refugees (and possibly rats) sailed to Con-

stantinople, Genoa, Venice, and other Mediterranean ports and are thought to have contributed to the second plague pandemic.³ However, given the complex ecology and epidemiology of plague, it may be an oversimplification to implicate the biological attack as the sole cause of the plague epidemic in Kaffa. Plague may have been imported into Kaffa by a natural cycle involving sylvatic and urban rodents and their fleas,^{4,5} and the population under siege may have been at increased risk of epidemics because of deteriorating sanitation and hygiene. Since plague-transmitting fleas leave cadavers to parasitize living hosts, we would suggest that the corpses catapulted over the walls of Kaffa may not have been carrying competent plague vectors.

... it may be an oversimplification to implicate the biological attack as the sole cause of the plague epidemic in Kaffa.

Smallpox was used as a biological weapon against Native Americans in the 18th century. During the French and Indian War (1754-1767), Sir Jeffrey Amherst, commander of British forces in North America, suggested the deliberate use of smallpox to "reduce" Native American tribes hostile to the British.⁶ An outbreak of smallpox at Fort Pitt resulted in the generation of fomites and an opportunity to execute Amherst's plan. On June 24, 1763, Captain Ecuyer, one of Amherst's subordinates, gave blankets and a handkerchief from the smallpox hospital to the Native Americans and recorded in his journal, "I hope it will have the desired effect."⁷ While this adaptation of the Trojan horse ruse was followed by epidemic smallpox among Native American tribes in the Ohio River valley,⁸ other contacts between colonists and Native Americans may have contributed to these epidemics.⁹ Smallpox epidemics among immunologically naive tribes of Native Americans following initial contacts with Europeans had been occurring for more than 200 years. In addition, the transmission of smallpox by fomites was inefficient compared with respiratory droplet transmission.⁹

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Both of these early attempts at biological warfare illustrate the difficulty of differentiating naturally occurring epidemics from alleged or attempted biological attack. This problem has had continued relevance because naturally occurring endemic diseases have been ascribed to alleged biological attacks for propaganda purposes.

THE ERA OF MODERN MICROBIOLOGY AND THE USE OF BIOLOGICAL WEAPONS DURING THE WORLD WARS

The formulation of Koch's postulates and the development of modern microbiology during the 19th century afforded the capability to isolate and produce stocks of specific pathogens. Substantial evidence suggests that Germany developed an ambitious biological warfare program during World War I, featuring covert operations in neutral trading partners of the Allies to infect livestock and contaminate animal feed to be exported to Allied forces.¹⁰ *Bacillus anthracis* and *Burkholderia (Pseudomonas) mallei*, the etiologic agents of anthrax and glanders, were to be used to infect Romanian sheep for export to Russia. Cultures confiscated from the German Legation in Romania in 1916 were identified as *B. anthracis* and *B. mallei* at the Bucharest Institute of Bacteriology and Pathology.^{4,5} *Burkholderia mallei* was allegedly used by German saboteurs operating in Mesopotamia to inoculate 4500 mules and in France to infect horses of the French cavalry.⁴ Argentinian livestock intended for export to Allied forces were infected with *B. anthracis* and *B. mallei*, resulting in the deaths of more than 200 mules from 1917 to 1918.⁴ Operations in the United States included attempts to contaminate animal feed and to infect horses intended for export during World War I.¹¹

In response to the horror of chemical warfare during World War I, international diplomatic efforts were directed toward limiting the proliferation and use of weapons of mass destruction. The first diplomatic attempt at limiting biological warfare was the 1925 Geneva Protocol for the Prohibition of the Use in War of Asphyxiating, Poisonous or Other Gases, and of Bacteriological Methods of Warfare.¹² This treaty prohibited the use of biological weapons. However, the treaty did not proscribe basic research, production, or possession of biological weapons, and many countries ratified the protocol while stipulating a right of retaliation.¹² There were no provisions for inspection. Parties to the Geneva Protocol that began basic research programs to develop biological weapons after World War I included Belgium, Canada, France, Great Britain, Italy, the Netherlands, Poland, and the Soviet

Union.¹³ The United States did not ratify the Geneva Protocol until 1975.

Japan conducted biological weapons research in occupied Manchuria from 1932 until the end of World War II under the direction of Shiro Ishii (1932-1942) and Kitano Misaji (1942-1945). Unit 731, a biological warfare research facility located near the town of Pingfan, was the center of the Japanese biological weapons development program and contained 150 buildings, 5 satellite camps, and a staff of more than 3000 scientists and technicians. Additional units were located at Mukden, Changchun, and Nanking. Prisoners were infected with pathogens including *B. anthracis*, *Neisseria meningitidis*, *Shigella* spp, *Vibrio cholerae*, and *Yersinia pestis*.^{13,14} At least 10 000 prisoners died as a result of experimental infection or execution following experimentation during the Japanese program between 1932 and 1945.¹⁴

As many as 15 million fleas were released per attack to initiate epidemics of plague.

Participants in the Japanese program who had been captured by the Soviet Union during World War II admitted to 12 large-scale field trials of biological weapons in testimony obtained during war crimes prosecution.^{15,16} At least 11 Chinese cities were attacked with biological agents. Attacks featured contaminating water supplies and food items with pure cultures of *B. anthracis*, *V. cholerae*, *Shigella* spp, *Salmonella* spp, and *Y. pestis*. Cultures were also tossed directly into homes and sprayed from aircraft.¹³⁻¹⁶ Plague was allegedly developed as a biological weapon by allowing laboratory-bred fleas to feed on plague-infected rats. These potentially infected fleas were then harvested and released from aircraft over Chinese cities. As many as 15 million fleas were released per attack to initiate epidemics of plague. Dr P. Z. King, director general of the Chinese National Health Administration, attributed epidemic plague to these attacks; however, rigorous epidemiologic and bacteriologic data are not available.¹⁷ In addition, the Japanese had not adequately prepared, trained, or equipped their own troops for the hazards of biological weapons. An attack on Changteh in 1941 reportedly led to approximately 10 000 biological casualties and 1700 deaths among Japanese troops, with most cases due to cholera.¹⁶ Field trials were terminated by Misaji in 1942, although basic research continued until the end of the war.¹⁴

Hitler reportedly issued orders prohibiting biological weapons development in

Germany. However, with the support of high-ranking Nazi party officials, German scientists began biological weapons research, although their results lagged far behind those of other countries. A German offensive biological weapons threat never materialized.¹⁸ Prisoners in Nazi concentration camps were forcibly infected with *Rickettsia prowazekii*, *Rickettsia mooseri*, hepatitis A virus, and *Plasmodia* spp and treated with investigational vaccines and drugs. These inhumane experiments were done to study pathogenesis, to develop vaccines against rickettsiae, and to develop sulfonamides rather than to develop biological weapons.¹⁸ The only known German tactical use of biological warfare was the pollution of a large reservoir in northwestern Bohemia with sewage in May 1945.¹ Ironically, the combination of a vaccine and a serologic test was used as a biological defense against the Nazis. The German army avoided areas with epidemic typhus by using the Weil-Felix reaction for diagnosis. Consequently, physicians used formalin-killed *Proteus* OX-19 as a vaccine to induce biological false-positive tests for typhus in an area of occupied Poland, and residents were protected from deportation to concentration camps.¹⁹

The Allies developed biological weapons for potential retaliatory use in response to German biological attack. Bomb experiments of weaponized spores of *B. anthracis* were conducted on Gruinard Island near the coast of Scotland and resulted in heavy contamination. Viable anthrax spores persisted until the island was decontaminated with formaldehyde and seawater during 1986.²⁰

THE US PROGRAM

In the United States, an offensive biological program was begun in 1942 under the direction of a civilian agency, the War Reserve Service. The program included a research and development facility at Camp Detrick, Md (renamed Fort Detrick in 1956), testing sites in Mississippi and Utah, and a production facility in Terre Haute, Ind. Experiments were conducted using pathogens, including *B. anthracis* and *Brucella suis*. However, the production facility lacked adequate engineering safety measures. For example, tests of the fermentation and storage processes using nonpathogenic *Bacillus subtilis* var *globigii* as a *B. anthracis* simulant disclosed contamination of the plant and environs. These findings precluded large-scale production of biological weapons during World War II, although 5000 bombs filled with *B. anthracis* spores were produced at a pilot plant at Camp Detrick.²¹ After the war, the production facility was leased and converted to commercial pharmaceutical production.²¹ Basic research and develop-

ment activities were continued at Camp Detrick. Ishii, Misaji, and other Japanese scientists in American custody who had participated in the Unit 731 program were granted immunity from war crimes prosecution on the condition that they would disclose information obtained during their program. Secret debriefings were conducted during the postwar era.^{13,16}

The US program was expanded during the Korean War (1950-1953). A new production facility incorporating adequate biosafety measures was constructed at Pine Bluff, Ark. Technical advances allowed large-scale fermentation, concentration, storage, and weaponization of microorganisms; production was begun in 1954. In addition, a program to develop countermeasures, including vaccines, antisera, and therapeutic agents to protect troops from possible biological attack, was begun in 1953.

Cities were surreptitiously used as laboratories to test aerosolization and dispersal methods . . .

Animal studies were performed at Fort Detrick, at remote desert sites, and on barges in the Pacific Ocean. Human experimentation using military and civilian volunteers was initiated in 1955. Biological munitions were detonated inside a 1-million-liter, hollow, metallic, spherical aerosolization chamber at Fort Detrick known as the "eight ball." Volunteers inside the chamber were exposed to *Francisella tularensis* and *Coxiella burnetii*. These and other challenge studies were done to determine vulnerability to aerosolized pathogens and the efficacy of vaccines, prophylaxis, and therapies under development. Additional studies were done using simulants. *Aspergillus fumigatus*, *B subtilis* var *globigii*, and *Serratia marcescens* were selected for use as simulants; these organisms were thought to be nonpathogenic and were used to study production and storage techniques as well as aerosolization methods, the behavior of aerosols over large geographic areas, and the effects of solar irradiation and climatic conditions on the viability of aerosolized organisms. Cities were surreptitiously used as laboratories to test aerosolization and dispersal methods when simulants were released during covert experiments in New York City, San Francisco, and other sites between 1949 and 1968.^{21,22,23}

Concerns regarding potential public health hazards of simulant studies were raised after an outbreak of urinary tract infections caused by nosocomial *S marcescens* (formerly *Chromobacterium prodigiosum*) occurred at Stanford Univer-

sity Hospital between September 1950 and February 1951.²⁴ The outbreak followed covert experiments using *S marcescens* as a simulant in San Francisco.²³ The outbreak involved 11 cases, resulting in 1 transient bacteremia and 1 death from endocarditis. All patients had undergone urinary tract catheterization, and 5 had undergone cystoscopy for urologic indications. Exposure to multiple antibiotics was cited as a contributing factor to the outbreak.²⁴ No similar outbreaks were reported by other hospitals in the San Francisco area. This outbreak is thought to represent an early example of nosocomial epidemics caused by opportunists of low virulence, related to antibiotic use, new medical devices, and surgical procedures.²⁵

In view of the temporal relationship of the outbreak with the simulant studies, the army convened an investigative panel in 1952, including members from the Communicable Disease Center, the National Institutes of Health, the City of New York Health Department, and Ohio State University. The panel did not comment directly on the possible association of the nosocomial outbreak and the simulant studies. The panel recommended continued use of *S marcescens* in view of its low virulence, but added that a search for better simulants to replace *S marcescens* should be pursued.²³ However, simulant studies using *S marcescens* continued until 1968. Public interest in these covert experiments was aroused in 1976 when the *Washington Post* reported them²⁶ and implied that the endocarditis death was a direct result of the simulant testing. It was further implied that sudden increases in the incidence of pneumonia in Calhoun County, Alabama, and Key West, Fla, were related to simulant studies at those locales. As a result of the ensuing public outcry, Senate hearings were held in 1977, and the army was severely criticized for the continued use of *S marcescens* following awareness of the Stanford outbreak.²²

Nonetheless, several facts cast doubt on an etiologic relationship between military use of *S marcescens* and outbreaks of human disease. The Centers for Disease Control reported that in 100 outbreaks of *S marcescens* infection, none was caused by the 8UK strain used by the army (biotype A6, serotype O8:H3, phage type 678).²⁷ Numerous reports during the 1970s postulated a link between the army experiments and cases of *S marcescens* endocarditis, septic arthritis, and osteomyelitis in California heroin addicts; where strains were available for testing, they were likewise shown to differ antigenically from the army test strain.²⁷ A review of the role of *S marcescens* in the army biological program was published in 1979.²⁵

Table 1.—Biological Agents Weaponized and Stockpiled by the US Military (Destroyed 1971-1973)

Lethal agents*
<i>Bacillus anthracis</i>
Botulinum toxin
<i>Francisella tularensis</i>
Incapacitating agents*
<i>Brucella suis</i>
<i>Coxiella burnetii</i>
Staphylococcal enterotoxin B
Venezuelan equine encephalitis virus
Anticrop agents†
Rice blast
Rye stem rust
Wheat stem rust

*Weaponized.

†Stockpiled, but not weaponized.

There were 456 cases of occupational infections acquired at Fort Detrick during the offensive biological program (1943-1969), at a rate of less than 10 infections per 1 million hours worked. The rate of occupational infection was well within the contemporary standards of the National Safety Council and below the rates reported from other laboratories. There were 3 fatalities due to occupationally acquired infections—2 cases of anthrax in 1951 and 1958 and a case of viral encephalitis in 1964. The mortality rate was lower than those of other contemporary surveys of laboratory-acquired infections. There were 48 occupational infections and no fatalities reported from production and testing sites. The safety program included the development and use of new vaccines as well as engineering safety measures.²³

By the late 1960s, the US military had developed a biological arsenal that included numerous bacterial pathogens, toxins, and fungal plant pathogens that could be directed against crops to induce crop failure and famine (Table 1).²³ In addition, weapons for covert use using cobra venom, saxitoxin, and other toxins were developed for use by the Central Intelligence Agency; all records regarding their development and use were destroyed during 1972.²⁸

KOREAN WAR AND COLD WAR ALLEGATIONS

The Soviet Union, China, and North Korea accused the United States of using biological warfare against North Korea and China during the Korean War. These accusations were supported by a series of investigations conducted by the International Scientific Commission, a group of scientists, and other organizations not part of the commission. Although these investigations were described as impartial, they were carefully controlled by the North Korean and Chinese governments.²⁹ The United States admitted to having biological warfare capabilities, but denied using biological weapons. The United States requested impartial investigations. The Interna-

tional Committee of the Red Cross suggested the formation of a special commission to investigate, and the World Health Organization offered to intervene. Neither China nor North Korea responded to the International Committee of the Red Cross, and the World Health Organization's offer was rebuffed as a disguised attempt at espionage. Consequently, the United States and 15 other nations submitted a resolution to the United Nations (UN) requesting the formation of a neutral commission to investigate the allegations; however, implementation of the resolution was prevented by the Soviet Union. The credibility of the United States was undermined by its failure to ratify the 1925 Geneva Protocol, by knowledge of its offensive biological warfare program, and the suspected covert collaboration with the Unit 731 scientists.²⁹ Although unsubstantiated, the accusations of US use of biological weapons attracted wide attention and resulted in a loss of international goodwill toward the United States. This episode demonstrated the propaganda value of biological warfare allegations, regardless of veracity.^{29,30}

Numerous unsubstantiated allegations were made during the cold war era. These included Soviet accusations of US biological weapons testing against Canadian Eskimos resulting in a plague epidemic³¹ and of a US and Columbian biological attack on Columbian and Bolivian peasants.³² The United States also was accused of planning to initiate an epidemic of cholera in southeastern China³³ and of the covert release of dengue in Cuba.³⁴

Similarly, the US allegations that Soviet armed forces and their proxies had used aerosolized trichothecene mycotoxins ("yellow rain"), potent inhibitors of DNA and protein synthesis derived from fungi of the genus *Fusarium*, in Laos (1975-1981), Kampuchea (1979-1981), and Afghanistan (1979-1981) are widely regarded as erroneous. The remote locations of the alleged attacks made intelligence investigations extremely difficult. Attacks were never witnessed by Western intelligence operatives, and samples of the aerosols were not recovered. Confounding factors included the following: contradictory testimonies from survivors of the alleged attack, discrepancies in reported symptoms, low disease rates in the allegedly exposed populations, the recovery of mycotoxin in less than 10% of the clinical and environmental samples submitted, the presence of *Fusarium* organisms as environmental commensals, the possible decay of toxin under prevailing environmental conditions, conflicting results of toxin assays from different laboratories, the similarity of alleged yellow rain deposits recovered from environ-

mental surfaces to bee feces in ultrastructural appearance and pollen and mold content, and the natural occurrence of show-ers of bee feces from swarms of honey bees in the rain forests of southeast Asia.³⁵

DISARMAMENT EFFORTS

During the late 1960s, there was increasing international concern regarding the indiscriminate nature, unpredictability, epidemiologic risks, and lack of epidemiologic control measures for biological weapons, as well as the ineffectiveness of the 1925 Geneva Protocol for preventing biological weapons proliferation. In July 1969, Great Britain submitted a proposal to the Committee on Disarmament of the UN prohibiting the development, production, and stockpiling of biological weapons and providing for inspections in response to alleged violations. During the following September, the Warsaw Pact nations submitted a biological disarmament proposal similar to the British proposal, but without provisions for inspections. Two months later, the World Health Organization issued a report regarding the potential consequences of biological warfare.³⁶ Estimates of the casualty figures that could result from biological attacks were staggering (Table 2).³⁶

Subsequently, the 1972 Convention on the Prohibition of the Development, Production, and Stockpiling of Bacteriological (Biological) and Toxin Weapons and on Their Destruction (BWC) was developed.³⁷ The treaty prohibits the development, possession, and stockpiling of pathogens or toxins in "quantities that have no justification for prophylactic, protective or other peaceful purposes." The BWC also prohibits the development of delivery systems intended to disperse biological agents and requires parties to destroy stocks of biological agents, delivery systems, and equipment within 9 months of ratifying the treaty. Transferring biological warfare technology or expertise to other countries is also prohibited. Signatories that have not yet ratified the BWC are obliged to refrain from activities that would defeat the purpose of the treaty until they explicitly communicate their intention not to ratify. However, there are unresolved controversies regarding the quantities of pathogens required for benevolent research and the definition of "defensive" research. Allegations of infractions may be lodged with the UN Security Council, which may in turn initiate inspections of accused parties; however, this provision is undermined by the right of Security Council members to veto proposed inspections.

The treaty was ratified in April 1972 and went into effect in March 1975. There were more than 100 signatory nations, including Iraq and the members of the Se-

Table 2.—Estimates of Casualties Produced by Hypothetical Biological Attack*

Agent	Downwind Reach, km	No. Dead	No. Incapacitated
Rift Valley fever	1	400	35 000
Tick-borne encephalitis	1	9500	35 000
Typhus	5	19 000	85 000
Brucellosis	10	500	125 000
Q fever	>20	150	125 000
Tularemia	>20	30 000	125 000
Anthrax	>20	95 000	125 000

*Release of 50 kg of agent by aircraft along a 2-km line upwind of a population center of 500 000.³⁶

curity Council (which included the United States and the Soviet Union). Review conferences were held in 1981, 1986, 1991, and 1996. Annual reports regarding biological research facilities, scientific conferences held at specified facilities, scientific exchanges, and epidemics are submitted to the UN as an additional confidence-building measure.³⁷

President Nixon terminated the US offensive biological weapons program by executive order in 1969 and 1970. The United States adopted a policy never to use biological weapons, including toxins, under any circumstances whatsoever. National Security Decisions 35 and 44, issued during November 1969 (microorganisms) and February 1970 (toxins), mandated the cessation of offensive biological research and production and the destruction of the biological arsenal. Research efforts were directed exclusively to the development of defensive measures such as diagnostic tests, vaccines, and therapies for potential biological weapons threats. Stocks of pathogens and the entire biological arsenal were destroyed between May 1971 and February 1973 under the auspices of the US Department of Agriculture, the US Department of Health, Education, and Welfare, and the Departments of Natural Resources of Arkansas, Colorado, and Maryland. Small quantities of pathogens were retained at Fort Detrick to test the efficacy of investigational preventive measures and therapies. The Central Intelligence Agency was admonished during a 1975 congressional hearing for illegally retaining samples of toxins after presidential orders mandating their destruction.²⁸

While many welcomed the termination of the US offensive program for moral and ethical reasons, the decision to terminate the offensive biological program was motivated by pragmatic considerations. Given the available conventional, chemical, and nuclear weapons, biological weapons were not considered essential for national security. The potential effects of biological weapons on military and civilian populations were still conjectural, and for obvious ethical and public health reasons could not be empirically studied. Biological weapons were considered untried,

unpredictable, and potentially hazardous for the users as well as for those under attack. Field commanders and troops were unfamiliar with their use. In addition, the United States and allied countries had a strategic interest in outlawing biological weapons programs to prevent the proliferation of relatively low-cost weapons of mass destruction. By outlawing biological weapons, the arms race for weapons of mass destruction would be prohibitively expensive, given the expense of nuclear programs.³⁸

After the termination of the offensive biological program, the US Army Medical Research Institute of Infectious Diseases (USAMRIID) was established to continue the development of medical defenses for the US military against potential biological attack. The mission of USAMRIID is to conduct research to develop strategies, products, information, and training programs for medical defense against potential biological weapons. Endemic or epidemic infectious diseases due to highly virulent pathogens requiring high-level containment for laboratory safety are also studied. The USAMRIID is an open research institution; no research is classified. The in-house programs are complemented by contract programs with universities and other research institutions.

FOLLOWING THE 1972 BWC

Several signatory nations of the 1972 BWC, including Iraq and the former Soviet Union, have participated in activities outlawed by the convention. These events demonstrate the ineffectiveness of the convention as the sole means for eradicating biological weapons and preventing further proliferation.

Biological weapons were used for covert assassination during the 1970s. Ricin, a lethal toxin derived from castor beans, was weaponized by the secret service of the Soviet Union and deployed by the Bulgarian secret service. Metallic pellets that were 1.7 mm in diameter were cross drilled, filled with ricin, and sealed with wax intended to melt at body temperature. The pellets were discharged from spring-powered weapons disguised as umbrellas. These weapons were used to assassinate Georgi Markov, a Bulgarian defector living in London, and during an unsuccessful assassination attempt against another defector, Vladamir Kostov, in 1978. Similar weapons may have been used for at least 6 other assassinations.³⁹

An epidemic of anthrax occurred during April 1979 among people who lived or worked within a distance of 4 km in a narrow zone downwind of a Soviet military microbiology facility in Sverdlovsk (now Ekaterinburg, Russia). In addition, livestock died of anthrax along the extended axis of the epidemic zone out to a

distance of 50 km.⁴⁰ The facility was suspected by Western intelligence of being a biological warfare research facility, and the epidemic was attributed by Western analysts to the accidental airborne release of anthrax spores.

The Soviets maintained that the epidemic was caused by ingestion of contaminated meat purchased on the black market. In 1992, Boris Yeltsin, the president of Russia, admitted that the facility had been part of an offensive biological weapons program and that the epidemic had been caused by a nonintentional release of anthrax spores.⁴¹ It was determined that air filters had not been activated early on the morning of April 3.⁴² Inhalation anthrax was identified at autopsy as the cause of death in victims.⁴³ At least 77 cases and 66 deaths occurred, constituting the largest documented epidemic of inhalation anthrax in history.⁴² The Soviets continued an offensive biological warfare program after the BWC of 1972 under the aegis of Biopreparat, an organization under the Ministry of Defense.⁴⁴ During the 1970s and 1980s, Biopreparat operated at least 6 research laboratories and 5 production facilities and employed up to 55 000 scientists and technicians.⁴⁵ The extensive program of the former Soviet Union is now controlled largely by Russia. Yeltsin stated in 1992 that he would end further offensive biological research and production⁴¹; however, the degree to which the program has been reduced is not known. A 1995 report estimated that the Russian program continues to employ 25 000 to 30 000 people.⁴⁶

Before the Persian Gulf War, intelligence reports suggested that the Iraqi regime had sponsored an ambitious biological warfare program. Coalition forces prepared for potential biological warfare by training in protective masks and equipment, reviewing decontamination procedures, and immunizing troops against potential biological warfare threats. Approximately 150 000 US troops received a Food and Drug Administration-licensed toxoid vaccine against anthrax, and 8000 received a botulinum toxoid vaccine approved by the Food and Drug Administration as an Investigational New Drug. In addition, 30 million 500-mg oral doses of ciprofloxacin were stockpiled in the theater of operations to provide a 1-month course of chemoprophylaxis for the 500 000 US troops in the event that anthrax spores were used as a biological weapon.

Information regarding the Iraqi offensive biological program was obtained after the Persian Gulf War during UN weapons inspections. Iraqi officials admitted to having had an offensive biological weapons program that included basic research on *B anthracis*, rotavirus, camel

pox virus, aflatoxin, botulinum toxins, mycotoxins, and an anticrop agent (wheat cover rust).^{46,47} Fortunately, biological weapons were not used during the Persian Gulf War. The Iraqi government claims to have destroyed its biological arsenal after the war. Research and production facilities that had escaped destruction during the war were demolished by the UN Special Commission on Iraq (UNSCOM) in 1996. The Persian Gulf War and postwar findings have led to a recent decision by the US military to develop a plan to immunize troops against anthrax.⁴⁸

The biological threat posed by non-state-sponsored terrorists was demonstrated by the intentional contamination of salad bars in Oregon restaurants with *Salmonella* Typhimurium by the Rajneeshee cult during late September 1984. This incident resulted in 751 cases of enteritis and 45 hospitalizations. Although the Rajneeshees were suspected, and despite rigorous epidemiologic analyses by the Wasco-Sherman Public Health Department, the Oregon State Health Division, and the Centers for Disease Control,^{49,50} the origin of the epidemic as a deliberate biological attack was not confirmed until a cult member admitted to the attack in 1985.^{51,52}

The threat of biological terrorism resurfaced following the Aum Shinrikyo sarin attack of the Tokyo subway system in March 1995. Police raids and investigations of the cult's facilities disclosed evidence of a rudimentary biological weapons program. The cult was allegedly conducting research of *B anthracis*, *Clostridium botulinum*, and *C burnetii*. The cult's arsenal seized by police allegedly contained botulinum toxin and drone aircraft equipped with spray tanks.⁵³ The cult had allegedly launched 3 unsuccessful biological attacks in Japan using *B anthracis* and botulinum toxin and had sent members to the former Zaire during 1992 to obtain Ebola virus for weapons development.⁵⁴

CONCLUSIONS

Allegations of biological attacks have been made since World War I. However, most of these have not been confirmed in the absence of compelling microbiological or epidemiologic data supporting a biological attack. Furthermore, the Rajneeshee incident in Oregon demonstrated that biological attacks may be easy to conceal despite state-of-the-art microbiological and epidemiologic analysis. These incidents underscore the difficulty of differentiating biological attacks from naturally occurring epidemics or endemic disease and emphasize the increased risk of epidemics during hostilities because of deteriorating hygiene, sanitation, and public health infrastructure. The practice of ascribing

naturally occurring epidemic or endemic diseases to alleged biological attacks for propaganda purposes demonstrates the perception of psychological vulnerability to the threat of biological warfare.

Confirmed incidents involving biological weapons since World War II include the Sverdlovsk accident, the ricin assassination attempts, the Rajneeshee incident, and the discovery of the Aum Shinrikyo biological weapons effort. The most immediate threat of biological warfare to date was posed by Iraq during the Persian Gulf War. The reasons behind Saddam Hussein's decision not to use his biological arsenal are unknown. The most frequently proposed hypothesis forwarded by Western military analysts and intelligence sources has been possible Iraqi concern regarding the risk of provoking massive retaliation. Alternatively, other considerations may have included

the possible ineffectiveness of Hussein's biological weapons and hazards to his own forces because of deficiencies in Iraqi training and equipment.⁵⁵

International agreements to limit biological weapons proliferation have not been completely effective, as evidenced by events in the former Soviet Union and Iraq, both of which demonstrated activities prohibited by the BWC of 1972. Efforts to formulate legally binding measures to verify compliance with the BWC have been undertaken but, as of the Fourth Review Conference in December 1996 in Geneva, Switzerland, such efforts have not been successful. Disagreements continue regarding the utility of routine inspections at biological research facilities and the political, economic, commercial, and security consequences of such inspections. The Ad Hoc Group of Government Experts on Verification will con-

tinue to negotiate measures to verify compliance and is charged to complete its work "as soon as possible," and no later than 2001. A Fifth Review Conference is to be held in 2001.^{56,57}

Concern continues regarding the possibility of proliferation or enhancement of state-sponsored, offensive biological weapons programs and the possible use of biological weapons by terrorist organizations. Following the termination of the US offensive program from 1969-1970, biological defense in the US military has focused on the development of countermeasures including detection capabilities, personal protective equipment, vaccines, diagnostics, and therapies to protect our military members.

This article is dedicated to the late Jay P. Sanford, MD, in appreciation for his invaluable contributions to the fields of infectious diseases, military medicine, and medical education.

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Iraq's Biological Weapons

The Past as Future?

Raymond A. Zilinskas, PhD

Between 1985 and April 1991, Iraq developed anthrax, botulinum toxin, and aflatoxin for biological warfare; 200 bombs and 25 ballistic missiles laden with biological agents were deployed by the time Operation Desert Storm occurred. Although cause for concern, if used during the Persian Gulf War, Iraq's biological warfare arsenal probably would have been militarily ineffective for 3 reasons: (1) it was small; (2) payload dispersal mechanisms were inefficient; and (3) coalition forces dominated the theater of war (ie, they had overwhelming air superiority and had crippled Iraq's command and control capability). Despite the Gulf War defeat, the Iraqi biological warfare threat has not been extinguished. Saddam Hussein remains in power, and his desire to acquire weapons of mass destruction continues unabated. In this context, the international community must be firm in its enforcement of United Nations resolutions designed to deter Iraq from reacquiring biological warfare capability and must take steps to develop a multidisciplinary approach to limiting future development of weapons of mass destruction.

JAMA. 1997;278:418-424

THE United Nations Special Commission (UNSCOM) and the International Atomic Energy Agency (IAEA) have investigated Iraq's weapons of mass destruction programs since April 1991. During 1995 and 1996, UNSCOM analysts were able to clarify most aspects of Iraq's biological warfare program. This article draws on information available in open sources¹⁻⁵ and my experience as a member of the UNSCOM investigation.

A biological weapon is more than just a pathogenic microorganism or toxin.^{6,7} It is a system composed of 4 major components—payload (the biological agent), munition (a container that keeps the payload intact and virulent during delivery), delivery system (missile, artillery shell, aircraft, etc), and dispersal mechanism (an explosive force or spray device to

dispense the agent to the target population). This report includes analysis of each component individually and their functioning in unison as a system.

IRAQ'S BIOLOGICAL WARFARE PROGRAM

After initial explorations in the late 1970s, Iraq's biological warfare program commenced in earnest in 1985. By the time Operation Desert Storm ended with a cease-fire in April 1991, Iraqi scientists had investigated the biological warfare potential of 5 bacterial strains, 1 fungal strain, 5 viruses, and 4 toxins. In addition, 2 bacterial species, *Bacillus subtilis* and *Bacillus thuringiensis*, were developed for use as simulants (ie, nonpathogens used for testing purposes).

Two pathogenic bacteria were studied—*Bacillus anthracis* (the cause of anthrax) and *Clostridium perfringens* (the cause of gas gangrene). Research on anthrax was initiated in 1985 at Muthanna State Establishment, the principal Iraqi chemical weapons facility, but was trans-

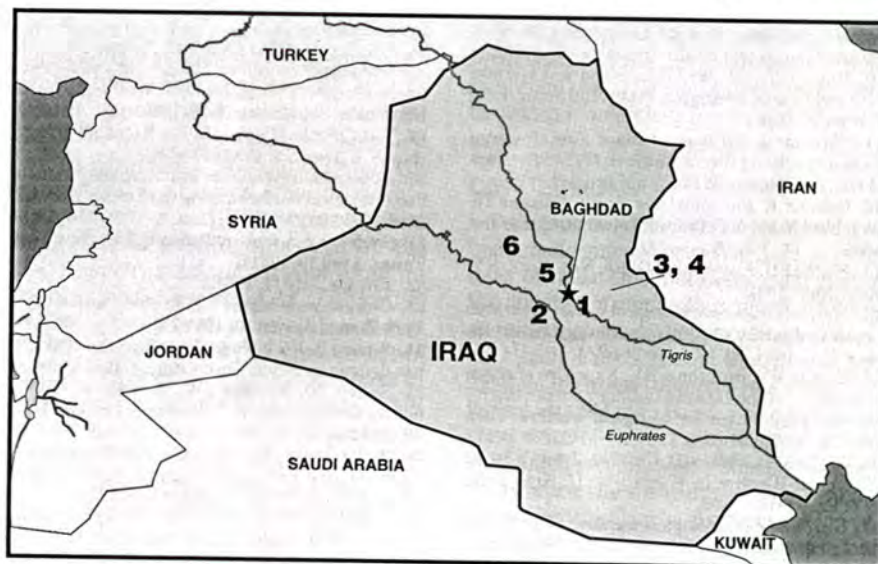


Figure 1.—Six major declared facilities involved in Iraq's biological weapons program: (1) Salman Pak; (2) Al Hakam Single-cell Protein Production Plant; (3) Daura Foot and Mouth Disease Vaccine Facility; (4) the Agricultural and Water Resources Research Center, Fudaliyah; (5) Taji Single-cell Protein Plant; and (6) Muthana State Establishment.

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All of the opinions and analyses expressed in this article are the author's own and do not necessarily reflect or agree with those of the agencies or organizations with which he has been associated.

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ferred in 1987 to Salman Pak just south of Baghdad, which became the center for biological warfare research and development (Figure 1). Some anthrax strains were imported from culture collections in France and the United States; others were local isolates. At Salman Pak, 4 strains were characterized, their media and storage requirements were established, and their pathogenicity was evaluated in animal models. Research findings were applied at the Al Hakam Single Cell Protein Production Plant, Iraq's major production facility for biological warfare agents, to begin mass production of anthrax in 1989. Eventually, approximately 8000 L of solution with an anthrax spore and cell count of 10^9 /mL was produced. Of this, 6000 L was used to fill weapons; the remainder was stored at Al Hakam (Figure 2).

A reference strain of *C. perfringens* was imported from the United States in 1985. Experimental work using mice commenced in 1988 to determine the infectivity of *Clostridium* spores, the ability of spores to initiate disease, and their degree of virulence. During 1990, 340 L of solution containing *Clostridium* was produced at Al Hakam. The Iraqis claim, however, that no attempt was made to develop *Clostridium* for weapons use.

One fungal strain with crop-destroying potential, wheat cover smut, was evaluated for use as a weapon. Research carried out at Salman Pak in 1985 demonstrated that wheat cover smut spores sprayed over immature wheat plants would be lethal to the crop. In 1988, young wheat plants growing in large fields near the town of Mosul were infected with this agent; the infected wheat subsequently was harvested and moved to Fudaliyah for storage. The Iraqis claim that no attempt was made to recover fungus from the harvest and that the infected crop was destroyed in 1990. The investigation of wheat smut implies that Iraqi leaders knew that biological weapons were more than antipersonnel weapons; they could also be used against crops as part of economic warfare.

Beginning in early 1990, scientists at the Foot and Mouth Disease Center at Al Manal investigated 5 viruses for their potential utility as biological weapons. Two agents, Congo-Crimean hemorrhagic virus and yellow fever virus, were found to be unsuitable since they required vectors for dispersal. The remainder, enterovirus 17, human rotavirus, and camelpox virus, were researched further, and a large egg incubator was obtained to mass produce the viruses. Reportedly, only certain growth characteristics of the viruses were elucidated before the program was terminated in 1990. Enterovi-



Figure 2.—Main facility for the production of biological warfare agents at Al Hakam Single-Cell Protein Plant (destroyed in June 1996). (Photo courtesy of UNSCOM.)

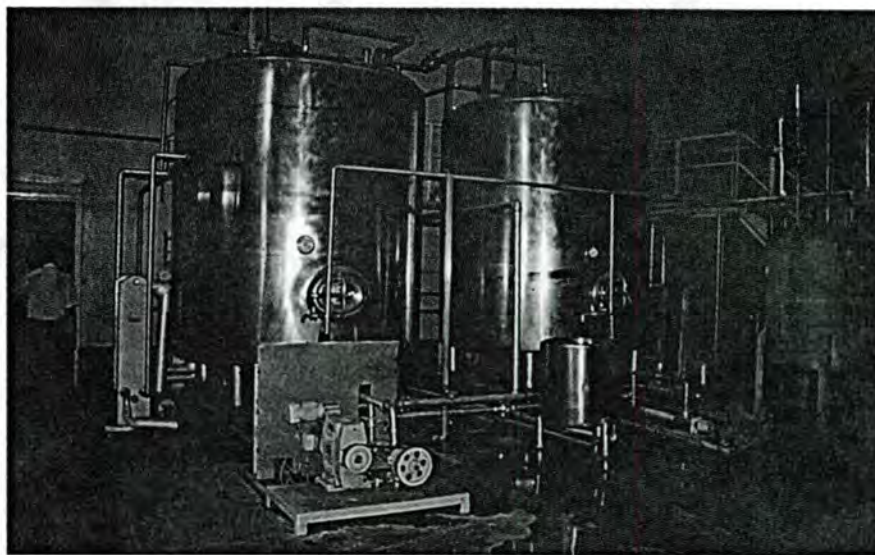


Figure 3.—Two 1450-L fermenters at the Al Hakam Single-Cell Protein Plant used to produce botulinum toxin for biological warfare. (Photo courtesy of UNSCOM.)

rus 17 and human rotavirus may have been investigated for use as incapacitating biological warfare agents (both cause gastrointestinal disorders), while camelpox might have been considered an "ethnic" weapon (ie, persons reared where no camels exist might prove especially susceptible to this zoonotic disease).

Substantial attention was given to weaponizing aflatoxin, botulinum toxin, ricin, and tricothecenes. (Many types of aflatoxin, botulinum, and tricothecene toxins are known to exist; however, since the Iraqis manufactured crude solutions containing undefined mixtures of toxin types, these toxins are referred to in the singular in this article.) Iraqi research of organisms that produce aflatoxin, including *Aspergillus flavus* and *Aspergillus parasiticus*, led to the development of methods for growing aflatoxin-producing organisms on wet rice. Individual types

of aflatoxin were identified, and some aflatoxin-containing solutions were tested in animal models. Production of aflatoxin began in 1989 at Salman Pak, where approximately 2200 L of solution was eventually manufactured. An unknown quantity of this cache was used to fill weapons; the remainder was stored.

Using a *Clostridium botulinum* strain imported from the United States, the Iraqis produced 20 000 L of solution containing botulinum toxin of unknown strength and type at Al Hakam and Al Manal during 1989 and 1990 (Figure 3). Of this, 12 000 L was used in field testing or to fill warheads; unused toxin was stored at Al Hakam.

The castor bean plant (*Ricinus communis*), grown widely in Iraq, naturally produces ricin. During 1989, approximately 10 L of concentrated ricin solution was manufactured at Salman Pak.

While some was tested in animal models and some used as payload in artillery shells, the fate of most is unknown. Ricin might have been researched because it is plentiful and known to be effective for assassination.⁸

In 1990, the ability of *Fusarium oxysporum* and *Fusarium graminearum* to produce tricothecene mycotoxins was investigated by Iraqi scientists. The fungi were grown on damp, supplemented rice; toxins were extracted by organic solvents and dried in a rotary evaporator. The Iraqis claim to have produced 20 mL of tricothecene-containing solution, some of which was tested in animal models. The fate of the remainder is unknown. Tricothecenes may have been investigated because some can penetrate skin or because of their alleged history as components of "yellow rain." (During the late 1970s, the US State Department alleged that the Vietnamese, abetted by the Soviet Union, had used toxin weapons against the H'mong and other native peoples of the Indochina peninsula.⁹ Supposedly, the main constituents of the dispersed agent, named yellow rain because of its appearance, were tricothecenes.)

The microbial and toxin agents produced at Al Hakam, Al Manal, and Salman Pak usually were transported to the Muthanna State Establishment, where they were used as payloads in various types of munitions.

Iraq's chemical arsenal included 250-lb (LD-250) and 400-lb (R-400) bombs. Based on successful chemical warfare, some of these bombs were adapted to hold 60 L and 85 L of biological solution, respectively. When deemed necessary, the walls of the chambers containing the payload were coated with an inert epoxy paint to protect the biological agents from the toxic effects of contact with metal. Testing determined that the R-400 was the more suitable munition for biological warfare. In 1990, 200 R-400 biological bombs were produced; of these, 100 were filled with botulinum toxin, 50 with anthrax, and 7 with aflatoxin. These biologically armed bombs were deployed at 2 sites, ready for immediate use.

A few 155-mm caliber artillery shells were filled with ricin for field testing. Reportedly, tests did not go well and no further attempts were made to develop artillery shells for biological warfare.

Iraq had procured more than 800 SCUD missiles from Soviet bloc countries before 1991 and had manufactured about 80 itself (most of which proved faulty). The SCUD had a range of 300 km and could carry high-explosive payloads of up to 1 metric ton. Some SCUDs, renamed Al Husseins, were enhanced to

double their range—although the trade-off was diminished payload capacity. In 1990, the Muthanna State Establishment received a special shipment of 100 Al Husseins. Of these, 25 were fitted with biological warheads: 13 with botulinum toxin, 10 with aflatoxin, and 2 with anthrax. All reportedly were deployed: 10 in a deep railway tunnel and 15 in holes dug along the Tigris River.¹⁰

The warheads of an unknown number of SAKR-18 122-mm rockets were filled with botulinum toxin, aflatoxin, or the simulant *B subtilis*, and field tested. As far as is known, no biological rockets were actually deployed.

All Iraqi munitions that depended on explosion for agent dispersal were of similar design—a tube filled with an explosive charge (burst) was placed in the center of a chamber containing the biological agent. At the moment of impact, the burst would explode, rupturing the outer wall of the munition and dispersing the payload.

The Iraqis possessed several hundred modern Italian-made pesticide dispersal systems that were fitted with sprayer nozzles capable of generating aerosols of the 1- μ m to 5- μ m size optimal for biological warfare. Some sprayers and appropriate holding tanks were installed on aircraft and land vehicles. Most important, in 1990, the Iraqis modified a MIG-21 fighter plane to be a remotely piloted vehicle and equipped it with a 2200-L belly tank (taken from a Mirage-F1 fighter plane) and a spray mechanism. In a field test carried out in January 1991, the remotely piloted vehicle sprayed a solution laden with a biological simulant over a practice target range. The results of this test are not known.

Soon after Iraq had accepted a ceasefire under United Nations Security Council Resolution 687 in April 1991,¹¹ biological warfare program personnel reportedly were ordered to destroy all biological warfare agents. A 2-step process was used for this purpose: first, stores of biological warfare agents were treated with formaldehyde and potassium permanganate; second, the residue was poured onto bare ground near Al Hakam's perimeter. Five years later, UNSCOM was unable to recover either residue or its breakdown products from the claimed dump sites. What this means is not clear. Natural forces might have completely degraded the residue over time, Iraqi authorities may be mistaken as to the location of dumps, or they may be lying about the purported destruction. Since UNSCOM cannot ascertain what took place, it is unable to independently verify the destruction of biological warfare agent stores.

Biological warfare munitions supposedly were destroyed at the same time as the agents. Bombs and warheads were opened and formaldehyde and potassium permanganate were added to the solution they contained. Later, munitions were crushed by bulldozers and burned in pits. Finally, the remains were concealed by detonating general purpose bombs among them. Many test munitions were simply thrown into the Tigris River. While some whole and many fragmented R-400s have been recovered by UNSCOM, it cannot certify that all biological bombs have been destroyed, nor does it have solid evidence on the fate of missile warheads.

Soon after Iraq had accepted a ceasefire . . . in April 1991, biological warfare program personnel reportedly were ordered to destroy all biological warfare agents.

United Nations Security Council Resolution 687 specifies that facilities and equipment used in support of any of Iraq's weapons of mass destruction programs are to be destroyed by UNSCOM or the IAEA. Actually, a few days before the first UNSCOM biological inspection team arrived at Salman Pak on August 2, 1991, the Iraqis themselves blew up part of the facility and covered it with a thick layer of dirt. In addition, some implicative equipment, such as aerosol test chambers, were removed and crushed. However, other biological warfare facilities remained operational and the Iraqis tried to conceal their real purpose. Nevertheless, their true function was eventually discerned.¹² Accordingly, in May and June 1996, Iraqi workers, overseen by UNSCOM inspectors, obliterated the Al Hakam plant and the equipment at Al Manal that had produced biological warfare agents.

ASSESSING IRAQ'S BIOLOGICAL WEAPONS CAPABILITY

Anthrax

In the past, anthrax has been weaponized by Japan,^{13,14} the United Kingdom,^{15,16} the United States,^{17,18} and the Soviet Union,^{19,20} so anthrax's attributes as a biological warfare agent are well known.^{21,22} Anthrax spores are extremely hardy, and they retain virulence during storage. Anthrax cells and spores dispersed in aerosol can inflict heavy casualties on unprotected populations, and if treatment with appropriate antibiotics is not begun soon after exposure, a morbidity rate of 65% to 80% will result.^{23,24}

Anthrax slated for weapons may be produced as slurry (an insoluble liquid mixture) or dry powder. Anthrax slurry, while easier to manufacture than powder, is less efficient for biological warfare purposes; agents in slurry lose virulence relatively quickly and, more importantly, slurry is troublesome to disperse as an aerosol with particles of optimal size.^{23,25} Yet, although Iraq possessed dryers and grinders that could have been used to produce dry anthrax, all of its deployed biological warfare munitions were filled with wet anthrax. The Iraqis may have been unable to overcome either the technical difficulties or the safety problems inherent in dry anthrax production.

Botulinum Toxin

Since botulinum toxin is the most toxic chemical known to science,^{26,27} biological warfare programs in other nations have investigated its military utility.²² While most cases of botulinum intoxication are caused by ingested contaminated food, aerosolized toxin is deadly.²⁸ For example, 8 kg of the concentrated botulinum toxin dispersed over an area of 100 km² would deliver a median lethal dose (LD₅₀) dose to the entire unprotected population located therein, assuming optimal meteorological conditions.²⁷ These properties may have proven attractive to the Iraqis who, as noted above, had produced large quantities of botulinum toxin-containing solution of unknown concentration. Given the extreme lethality of the agent, it is reasonable to assume that this solution would be deadly in small doses if delivered effectively to unprotected persons.²⁹

Aflatoxin

It is difficult to understand why the Iraqis developed aflatoxin for weapons use. Although well known to medical science as a powerful nephrotoxin and hepatotoxin,^{28,30} aflatoxin has no known property useful for biological warfare. Possible explanations for Iraq's interest in aflatoxin include (1) Iraqi scientists may have discovered that aflatoxin possessed a previously unknown property useful for biological warfare applications; (2) Iraqi planners may have intended to use aflatoxin's long-term carcinogenic properties as a means of terrorizing targeted civilian populations; or (3) since aflatoxin is easier to manufacture than most other toxins, the Iraqi biological warfare program's staff might have chosen to produce it to meet production goals set by higher authorities, rather than for its perceived biological warfare value. Whatever the case, Iraq's aflatoxin-based weapons had little military utility.

The Tactical Threat

Though in possession of several hundred biological weapons, Iraq's tactical biological warfare capability during the Persian Gulf War actually was quite limited. As noted, Iraqi biological warfare munitions depended on impact detonation for primary dispersal of agents. This method is exceedingly inefficient because (1) an explosion inevitably renders harmless much of the payload; (2) impact detonation drives a substantial part of the payload into the ground; (3) the small part of the payload aerosolized by explosion generally is not propelled beyond a few tens of meters; and (4) the size of aerosolized particles varies widely, from large clumps to particles of smaller than 1 μ m. (Large particles would settle quickly to the ground, while fine dust would be quickly dispersed by wind.) For these reasons, had Iraq's biological warfare munitions actually been used, their effect would have been limited to contaminating a relatively small area of ground surrounding the point of impact and exposing nearby individuals to aerosolized pathogens or toxins. In addition, Al Husseins lacked an inertial guidance system, which made them inaccurate.³¹ Therefore, biological-laden Al Husseins launched in support of tactical military missions probably would have missed the target.

Biological agents delivered by aerosol would have presented a more credible threat to coalition forces, but such a system most probably was not in use during Operation Desert Storm.

The defensive capabilities of coalition forces also must be taken into account. First, coalition forces had overwhelming air superiority and unsurpassed ability to detect and destroy airborne aircraft. In addition, Iraq's meteorological stations and communications network had been destroyed by coalition bombings.³¹ Without accurate forecasts, airborne biological agents might have been blown onto friendly forces or been dispersed over empty desert. Second, coalition forces had been trained to expect chemical attacks by Iraq, and were well equipped to defend themselves. The standard antichemical defense methods and equipment would also have provided adequate protection against all known Iraqi biological weapons.

However, protection comes at a cost. The military effectiveness of troops garbed in protective suits is decreased because the ability of soldiers to perform complex manual tasks is limited, their observational powers reduced, and they tire quickly, especially in hot weather.³² Therefore, just by making its opponents believe that a biological attack was im-

minent, the Iraqis would have forced them to garb themselves, which would have impaired the coalition forces' combat effectiveness and mobility.

Investigations of US forces taking part in the Persian Gulf War found several deficiencies with biological warfare defense preparedness, including shortfalls in defensive equipment, inadequate training, and shortages in medical support.^{33,34} However, the primary weakness of the coalition forces in regard to biological warfare was that they did not have "stand-off" or "point detection" capabilities (ie, they could not reliably detect agent-laden aerosol clouds or plumes created by explosion at a distance or on-site). Therefore, had the Iraqis against all odds been able to mount a surprise attack using aerosol laden with anthrax or botulinum toxin and had wind conditions been such that the aerosol was carried into positions held by coalition forces, the attack probably would not have been detected. Thus, no warning would have been sounded for troops to protect themselves by garbing or seeking shelter. Because only approximately 150 000 troops received the first vaccination against anthrax and a smaller proportion of that 150 000 received a second vaccination³⁵ (6 vaccinations in 1 year are necessary for full protection), the first indication of the attack would have appeared 3 to 6 days later when soldiers began to present symptoms of pneumonic anthrax. Although anthrax is treatable by commonly available antibiotics, it is questionable whether sufficient supplies would have been on hand to adequately treat a large number of exposed individuals.

Had the Iraqis been able to attack the coalition forces' rear positions, such as airfields, ports, and troop assembly areas, with anthrax or botulinum toxin aerosol, a similar situation would have ensued. Heavy casualties among troops and civilian workers, compounded by panic, would have caused serious disruptions. The coalition forces' ability to operate would have been severely compromised as the flow of vital supplies decreased to a trickle, communications were hindered, and medical facilities overwhelmed.

The Threat Posed to Civilian Populations

During the Iraq-Iran war of 1980 to 1986, 1 episode (called the War of the Cities) demonstrated that the Iraqi leadership is capable of ordering attacks on purely civilian targets. It began when the Iraqis launched missiles against helpless Iranian cities of no obvious military value. The Iranians retaliated in kind.³⁶ After an exchange of several hun-

dred missiles, the episode ended with, apparently, neither side having gained militarily from the exchange. The cost to both, however, was immense—many thousand dead and wounded civilians, as well as incalculable misery for hundreds of thousands of city dwellers.

Cities were also targeted during the Persian Gulf War but on a much smaller scale. The Iraqis launched 39 SCUD missiles against Israeli cities,³⁷ but the Israelis chose not to retaliate. Although all missiles launched against Israel carried high explosive warheads, Iraq was capable of having launched Al Husseins with biological warheads. If this had occurred, what would the consequences have been?

Since cities occupy large areas, it is likely some of the Al Husseins would have reached their targets. (Also, solitary bombers equipped with R-400 bombs might have evaded detection by hugging the ground.) While the number of casualties caused directly by biological weapons probably would have been low, the targeted population's terrified reaction to these bombs or missiles may have caused more harm than the weapons themselves. (For example, of the 1060 Israeli casualties [including 11 deaths] caused by Iraqi missiles, only 234 injuries [2 deaths] resulted from explosion.³⁷) The combination of direct casualties brought about by disease in combination with casualties caused by the resultant panic likely would have caused more injuries and death than were produced by high explosives.³⁸⁻⁴¹ The outrage felt by the Israeli population most likely would have compelled Israel to retaliate and, perhaps, enter the Persian Gulf War.

A RESURGENT IRAQI WEAPONS OF MASS DESTRUCTION PROGRAM

Had Operation Desert Storm not intervened, it is likely that Iraq would have possessed a formidable suite of weapons of mass destruction by 1997.^{10,42,43} It could have deployed ballistic missiles with a range of about 2000 km capable of delivering up to a 1-ton payload. Further, Iraqi commanders would have been able to select the type of warhead required for a particular mission. Thus, a nuclear or biological warhead might have been used to achieve a strategic objective; for example, to destroy the capital of a neighbor or to threaten more distant nations that might wish to intervene on the side of Iraq's opponent in any conflict. If, on the other hand, a tactical strike was to be undertaken, for example, the destruction of a smaller target such as a troop formation, a short-range missile fitted with a chemical warhead might have

been appropriate. Thus, the ballistic missile component was the heart of Iraq's weapons of mass destruction program; each missile could have been fitted with a warhead appropriate for achieving the tactical or strategic objective set for it before launching.

A resurgent overt program by Iraq to develop weapons of mass destruction is, for now, deterred by UNSCOM's and the IAEA's ongoing monitoring and verification program and the imposition of import and export controls.^{44,45} If these agencies were removed from Iraq, either by the United Nations Security Council deciding to terminate their missions or by the Iraqi government expelling them, Iraq might restart such a program. If so, it probably would be reconstructed along lines familiar to Iraqi planners, beginning with the acquisition of a powerful ballistic missile capability.

It appears that Iraq may already be on its way to realizing such a capability. The main missile research station, Sa'ad 16 located at Al Kindi, which was demolished by bombs during the Persian Gulf War, has been completely rebuilt.⁴⁶ Iraq possesses hundreds of ballistic missiles with a range of 150 km or less allowed by the terms of the 1991 cease-fire. It may also possess HY-2, SS-N-2, and C-601 cruise missiles,¹⁰ although UNSCOM has seen no firm evidence of this. The United Nations Special Commission has dismantled or otherwise accounted for the destruction of most of the SCUD missiles that survived the Persian Gulf War, but commission members still believe some operational SCUD missiles remain undetected. Iraqi rocket scientists are believed to be honing their skills while working for Libya's leader, Mu'ammar Qaddafi.⁴⁷ For these reasons, and despite limitations imposed by UN Security Council Resolution 647, Iraq might already possess potent ballistic and, perhaps, cruise missile capabilities and the trained personnel to deploy and operate them.

The question then is this: What kind of warheads could be fitted to these missiles to meet Iraq's desire for weapons of mass destruction? Nuclear warheads cannot be acquired for at least 5 years because the IAEA has destroyed most if not all Iraqi nuclear weapons-related facilities.^{41,48-52} Similarly, UNSCOM has supervised the destruction of most, perhaps all, of Iraq's chemical warfare agents, as well as equipment and facilities used by the chemical warfare program.^{1,2,3,5} Thus, no chemicals would be available immediately to arm ballistic missiles (unless hidden stores of agents remain).

The situation differs markedly in regard to biological warfare. The workforce of more than 200 persons who

staffed Iraq's biological warfare program is intact. Iraq's civilian biotechnological infrastructure, comprising more than 80 research, development, and production facilities, is whole and well equipped.⁵³ Since most biotechnological equipment is dual use, some of the currently operative facilities could be rapidly converted to biological warfare work. It is prudent to assume that the Iraqis retain hidden stores of freeze-dried organisms from its former biological warfare program. Because Iraq maintains these human, biological, and industrial resources, it could reconstitute a biological warfare program rapidly and be able to manufacture militarily significant quantities of biological warfare agents within 6 months. Further, the armorers who adapted chemical munitions to hold biological agents before the Persian Gulf War are still available. With their assistance, stockpiled conventional munitions could be modified within the 6-month time frame and loaded with biological warfare agents.

... it [Iraq] could reconstitute a biological warfare program rapidly and be able to manufacture militarily significant quantities of biological warfare agents within 6 months.

Weapons produced immediately by a resurgent Iraqi biological warfare program, even if unimproved over the weapons developed before 1991, could be deployed in support of aggressive moves. Except for the coalition partner countries and Israel, the armed forces of the region's nations probably are inadequately prepared to defeat a biological attack. (All have chemical warfare training and doctrines, but are desultory about implementation.) Further, all of the region's civilian populations are unprotected. Thus, if Iraq were able to maintain secrecy and deploy biological weapons to tactical sites, opponents would face a very difficult situation because most soldiers and all civilians would be vulnerable both to diseases brought about by biological warfare agents and to panic that these weapons would induce among threatened or attacked populations. Clearly, by once again possessing these weapons, Iraq would be in a position to intimidate neighboring countries.

If the Iraqi leadership were patient, its biological weapons could be significantly improved in a short time. Thus, within a year of commencing a resurgent program, it is probable that Iraqi scientists could perfect techniques for drying biological warfare agents and engineers could install improved aerosol-forming

and disseminating equipment on suitable aircraft. Thereafter, remotely piloted vehicles, long-range fighter-bombers, or cruise missiles equipped with tanks and sprayers and programmed to avoid detection by flying low and following ground contours could reach populations located within 1000 km of Iraq's borders and disperse agents under conditions favorable for carrying out a successful biological attack. With these added capabilities, Iraq would be able to mount a militarily significant biological threat to even the most powerful opponent in the region.

CONCLUSIONS

The Iraq of today is similar to Iraq before the Persian Gulf War—it has the same leader and form of governance, it possesses a large and powerful army and air force, and it is able to deploy a large, well-trained civilian workforce. Its oil reserves are the world's third largest, and the infrastructure for oil exploitation has been rebuilt and is gearing up for full production. As to its geopolitical standing, the same uneasy, distrustful relations exist between Iraq and its neighbors as before; in fact, Iraq's leader may perceive himself as even more beleaguered and as having additional scores to settle. In consideration of this unsettled situation, it is wise to prepare for the possibility of Iraq's trying once again to gain a dominant position in the Middle East.

It is reasonable to assume that, as before, Iraq will attempt to overcome the numerical superiority of regional opponents by resorting to the use of weapons of mass destruction. Iraq's former ballistic and cruise missiles and biological warfare components would be the easiest and quickest to reassemble. How can such disquieting developments be prevented?

The key barrier to Iraq reacquiring weapons of mass destruction undoubtedly is the collective international will that sustains the several United Nations Security Council resolutions designed to ensure a subdued Iraq. A further reflection of that will is the support the council gives UNSCOM, especially with regard to biological warfare. Before the Persian Gulf War, Iraq placed high priority on developing a strong biotechnological capability. This effort will probably be continued and expanded once the United Nations lifts economic sanctions. The Iraqi government may attempt to apply biotechnology for various legitimate enterprises, including enhancing the ability of crop plants to withstand abiotic and biotic stress, manufacturing biological fertilizers and pesticides, producing single-cell protein, and developing diagnostic methods for animal and human

diseases. Due to the dual-use character of biotechnology, however, much of the expertise, equipment, supplies, and facilities devoted to civilian biotechnological pursuits could be redirected to biological warfare applications. The UN Commission's actions to closely and continuously monitor Iraq's biological research, development, production, and testing facilities is the best guarantee that these facilities are unable to take up such work. Further, UNSCOM's awareness of the locations of Iraq's bioscientists and chemical engineers who staffed the former biological warfare program makes it less likely that they could be used by secret facilities to perform illicit research and development. As long as UNSCOM is able to continue fulfilling its monitoring responsibilities, Iraq's leadership is likely to be deterred from biological warfare acquisition. Clearly, UNSCOM must remain fully operational until such time as a leadership is established in Iraq which poses no threat to its neighbors.

The Iraq of today is similar to Iraq before the Persian Gulf War . . .

Possibly the most important lesson for international arms control that can be drawn from UNSCOM's experiences relates to the need to apply broad, multidisciplinary expertise to arms control. The Iraqis took a "holistic" approach toward acquiring weapons of mass destruction (ie, rather than seeking to acquire only 1 type of weapon, it sought to acquire a comprehensive arsenal with ballistic missile, biological, chemical, and nuclear components). The agencies charged with destroying Iraq's former weapons of mass destruction program and making certain that it is not resurrected, UNSCOM and IAEA, were able to address this multifaceted problem by fielding inspection teams that included biological, chemical, and ballistic missile experts. No international treaty compliance regime is so flexible.

As matters now stand, international arms control treaties are disciplinary (ie, each treaty addresses 1 type of weapon system, be it nuclear, chemical, or biological). Further, each treaty that specifies the establishment of a compliance regime, such as the Chemical Weapons Convention, also contains provisions that limit that regime's detection and monitoring functions to the discipline under the treaty's purview. Since no international arms control treaty has an interdisciplinary reach, no compliance regime has the capability to operate in a multidisciplinary weapons of mass de-

struction environment. For example, a Chemical Weapons Convention inspection team probably would not be able to detect activities that contravene treaties bearing on biological or nuclear weapons, and if such activity was detected, the team would be reporting to a treaty secretariat that could not act on this information.

The international arms control community must reassess its disciplinary approach. An improved response would be to negotiate multidisciplinary arms control treaties that encompass several types of weapons of mass destruction. The primary drawback to this approach is that negotiations to achieve multidisciplinary arms control treaties would be even more complex and drawn out than the difficult and extended negotiations undertaken to achieve single discipline treaties. For example, it took almost 20 years to accomplish the Chemical Weapons Convention. Yet, even while recognizing the problems inherent in developing multidisciplinary arms control treaties, it seems worthwhile to consider such a response. Nations that belong to all major disarmament treaties, including the Biological Weapons and Toxins Convention, Chemical Weapons Convention, and the Nuclear Nonproliferation Treaty, would be in a good position to initiate this effort.

A response that could be accomplished more easily and quickly would be to establish 1 facility where all the compliance regimes would be headquartered. The tendency now is to headquarter each compliance regime in a city that offers the best package of inducements to the respective treaty organization. For example, the Chemical Weapons Convention compliance regime is located in The Hague and the Nonproliferation Treaty compliance regime is in Vienna. Substantial benefits could be derived from taking this unifying step: (1) it would make it easier to create an environment where experts from all disciplines could consult with one another; (2) the international arms control community could set up a comprehensive, unified computerized database containing information from all disciplines; and (3) costs would be reduced by eliminating the need for separate facilities for each compliance regime. Most important, by gathering the various treaty compliance regimes under one roof and taking steps to ensure that they communicate continuously with one another, the international arms control community would ensure that a major lesson from the experience in Iraq has been learned, namely, the need to take an interdisciplinary approach towards limiting the development and use of weapons of mass destruction.

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The Threat of Biological Weapons

Prophylaxis and Mitigation of Psychological and Social Consequences

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The microbial world is mysterious, threatening, and frightening to most people. The stressors associated with a biological terrorist attack could create high numbers of acute and potentially chronic psychiatric casualties who must be recognized, diagnosed, and treated to facilitate triage and medical care. Media communications, planning for quarantine and decontamination, and the role of community leaders are important to the mitigation of psychological consequences. Physicians will need to accurately diagnose anxiety, depression, bereavement, and organic brain syndromes to provide treatment, reassurance, and the relief of pain.

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BIOLOGICAL WEAPONS have emerged as a significant threat in the 1990s.^{1,2} Other reports in this issue have established the potential likelihood of the use of biological weapons and the nature of the biological and toxic threats. Herein, we discuss the psychophysiological and social implications of such agents and propose recommendations for developing primary interventions and treatment.

PSYCHOSOCIAL RESPONSES FOLLOWING A BIOLOGICAL ATTACK

The idea of infection caused by invisible agents is frightening. It touches a deep human concern about the risk of being destroyed by a powerful, evil, imperceptible force. These beliefs activate emotions that are extremely difficult to direct with the tools of reason. The response of specialists in medicine, epidemiology, infectious disease, molecular biology, nursing, and emergency medical services can bring some discipline and rationality to this situation. To be effective, the response must be well organized and communication must be made in terms that the public understands. Multiple organizations with conflicting and overlapping goals and responsibilities (eg, health care, law enforcement, and social welfare) may increase the confusion and anxiety for the individual and community. The novelty of biological

weapons in combination with the activation of deeply rooted fears predict that strong psychological and physiological responses will occur.

The immediate stressors associated with a biological terrorist attack are the threat and the consequences of infection. The specific nature of these stressors will depend on the organism or toxin used. Characteristics such as the incubation period and the virulence and toxicity of the agent will contribute to the psychological impact. The process of seeking and receiving immunization or treatment is potentially stressful. Examples of common psychosocial responses are noted in Table 1.

One can anticipate that there will be acute and chronic psychiatric casualties as in other disasters.³⁻⁶ While the majority of people do not develop long-term psychiatric sequelae following disasters, certain groups are at higher risk (eg, the previously traumatized, those without social supports, and first-responders, such as police and emergency medical personnel). Biological agents may cause mental disorders due to toxins or infectious conditions such as viral encephalitis or bacterial meningitis. Illness and injury secondary to the attack increase the risk of the development of acute stress disorder and posttraumatic stress disorder, as well as depression and bereavement in survivors.^{7,8} Psychiatric disability is a likely chronic outcome of biological attack. The incidence and prevalence of such problems remain a matter of speculation, although past occurrences can be used to anticipate consequences. Experiences with chemical weapons used by terrorists have demonstrated that psychiatric casualties are likely.⁹

The psychiatric sequelae will depend on the nature of and the response to the assault. In contrast to explosive or chemical weapons, biological weapons may not produce instantaneously horrifying results. (An exception to this might be the use of a biological toxin that kills quickly and with frightening manifestations, such as seizures or suffocation.)

As the attack is discovered and the media reports the news, exposed and unexposed individuals may experience acute autonomic arousal. Signs and symptoms of muscle tension, tachycardia, rapid breathing (perhaps hyperventilation), sweating, tremor, and a sense of foreboding are likely to generate health concerns. These signs and symptoms may be misattributed to infection or intoxication. The acutely stressed and symptomatic individuals will add complexity and additional patients for triage during the initial phase of the crisis. However, if initial triage and management are successful, the risk for the development of psychiatric problems can be minimized.

Forensic issues involved in the medical response influence psychological responses and treatment options. Preservation of evidence maximizes the possibility of the perpetrators' being punished. The perception that justice is ultimately served can have a very positive psychological impact on those exposed and society. Some survivors may be critical witnesses in future legal actions. This may have little consequence for immediate lifesaving care, but it might prompt the selection of psychotropic drugs that minimally interfere with recall or discourage the use of a technique, like hypnosis, that can potentially damage the future credibility of a witness report.

ACUTE INTERVENTION FOLLOWING A BIOLOGICAL ATTACK

Rapid, accurate triage and effective treatment (or immunization) will be the cornerstones of initial management (Table 2). Distinguishing symptoms of hyperarousal from those of intoxication and infectious disease prodromes will be

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Table 1.—Psychological Responses Following a Biological Terrorist Attack

Horror
Anger
Panic
Magical thinking about microbes and viruses
Fear of invisible agents
Fear of contagion
Anger at terrorists, government, or both
Attribution of arousal symptoms to infection
Scapegoating
Paranoia
Social isolation
Demoralization
Loss of faith in social institutions

Table 2.—Psychiatric Intervention

Prevention of group panic
Careful, rapid medical evaluation and treatment
Avoidance of emotion-based responses (eg, knee-jerk quarantine)
Effective risk communication
Control of symptoms secondary to hyperarousal
Reassurance
Diazepamlike anxiolytics for acute relief, as indicated
Management of anger, fear, or both
Management of misattribution of somatic symptoms
Provision of respite as required
Restoration of an effective, useful social role (perhaps as worker at triage site)
Return to usual sources of social supports in the community

crucial. The type of exposure and any lack of complete information about the agent will increase uncertainty and the risk of psychiatric morbidity. The risk for secondary psychological trauma will increase if actions by leaders or helpers fail to provide a quick, accurate diagnosis, a sensitive process for communicating the nature of the risk, and a supportive environment for those exposed and their families.

An attitude of expectation that those with hyperarousal or demoralization will soon return to normal activities should be conveyed. Patients should be moved out of the patient role as quickly as possible. Diazepamlike anxiolytics may be helpful in reducing anxiety for patients who do not respond to reassurance. The assignment of simple work tasks that facilitate the care of other patients can help restore function to the psychological casualties. The recovery environment should be constructed to create a sense of safety and to counteract the helplessness induced by the terrorist act.¹⁰

A well-organized, effective medical response contributes to the creation of a supportive environment and accurate data for the at-risk population. Individuals can assess their risk and determine the actions that they can take to reduce the risk. Ideally, risk information should involve dialogue. Dialogue lets the at-risk population define the information that they need, and it enables the community leaders to assess their effectiveness in communicating the appropriate

data. Failure to provide a public forum for information exchanges may actually increase anxiety and misunderstanding and amplify health concerns since individuals will tend to attribute autonomic symptoms to catastrophic illness. One consequence of appraisal error may be disabling somatic complaints offered in a setting where failure to find a medical or surgical disease is experienced as stigmatizing and sadistic by the patients. In this situation, the patient's life may become focused on an unending search for an "acceptable" diagnosis.¹¹⁻¹³

IMPLICATIONS OF PSYCHOLOGICAL REACTIONS FOR THE MEDICAL SYSTEM

Following a biological terrorist attack, physical injury, disruption of daily communal routine, and increased use of public health facilities could place overwhelming demands on the medical systems.¹⁴ Feelings of helplessness and hopelessness could be increased if the rescue and postdisaster medical efforts appear to be failing.¹⁵ Angry, intense competition for available but limited resources can generate even more societal disruption and casualties. The belief that treatment will be provided to some but not to others will contribute to the possibility of social disruptions such as riot or panic. Panic will be a particular risk when biological agents are used to threaten or to attack a sizable civilian population.¹⁶ Demoralization can also be a response to the predicaments presented by a biological attack. Demoralized individuals often lose their sense of social and group responsibilities and roles. If major community institutions fail to provide protection, citizens can lose faith in the ideological metaphors that bind the community together. In this way, demoralization can increase isolation and feelings of hopelessness. In this complex setting, some are likely to manifest psychiatric symptoms. Given the stigma attached to psychiatric illness and the fact that the individuals who manifest them are more likely to have been injured and to have been exposed to multiple infectious, environmental, and toxicological risks, the diagnostic and therapeutic dilemmas will be quite difficult.^{17,18}

Quarantine requires the development of a specialized environment that will limit exposure to secondary infections. The creation of such an environment may disrupt social supports that reduce the postexposure risk of stress-induced disorders. It can create a situation characterized by separation from friends and family, isolation, and a sense of stigmatization. Prior planning can ensure that modern communication technology (telephone, television, and computer Internet connection)

can be used to mitigate these untoward effects by providing ongoing contact with families and others in the community outside quarantine. The maintenance of contact between parents and children is particularly important for the children. This may result in putting unexposed adult caregivers in quarantine.

Additional stressors may arise from the mundane logistical demands associated with managing mass contamination and infection. One of the difficulties in the Japanese sarin attack was undressing patients and disposing of their clothing.⁹ Obtaining the necessary shower facilities for a large number of exposed survivors may be problematic. The provision of privacy and assurance of conventional modesty may have to be sacrificed. It should not be forgotten that privacy and modesty are important to maintaining an individual's sense of control and autonomy. The imposition of special requirements such as public bathing should be accompanied by an explanation that attributes this undesirable demand to the terrorist attacker.

Disaster responders and medical personnel also will have to contend with their own psychological reactions. One of the terrorist's goals is to provoke intense emotions that interfere with the capacity of caregivers to react in a thoughtful, organized fashion. A biological attack using a highly infectious and virulent organism (eg, anthrax), dispersed in a fine spray, poses special stressors. Medical responders may be required to work in protective clothing and masks ("moon suits"). This barrier protection will make the care of patients more difficult and increase the risk of heat, fatigue, and isolation stress for medical personnel.^{19,20} It will be important to establish work-rest schedules and to limit the exposure of medical and rescue personnel to the grotesque and the dead.

PLANNING AND PREPARATION

Disaster plans for managing a biological attack must be developed and realistic training provided to ensure effective response to an actual terrorist event. These plans must assume that emotional and psychiatric problems will occur in the unexposed population as well as the exposed. The exercises should be carried out with sufficient realism, so that the process of disrobing and showering is practiced in real time. Medical responders will need training to recognize the symptoms of anxiety, depression, and dissociation. It is critical that psychological responses be managed in ways that facilitate the triage, diagnosis, and treatment of those exposed or infected.²¹ Such plans need to include strategies for prevention and mitigation of stress for survivors as well as for those responding to the crisis

and its consequences. Debriefing, commonly used by emergency personnel following trauma, has been used to mitigate the effects of severe stress and can be helpful in identifying individuals who may need further assistance. Results from controlled studies of debriefing are only now beginning to become available.^{22,23} These studies will help clarify the role of intervention in the alleviation of pain, prevention of disability, return to social involvement, and the prevention of disease. Ironically, should a highly infectious agent be used, bringing people together for a debriefing may be contraindicated. Perhaps "teledebriefing" (analogous to telemedicine) is a technology that could be developed for such situations.

COMMUNICATING RISK TO THE PUBLIC

The communication of the risk to individuals following a bacteriologic attack will critically affect how communities and individuals respond.²⁴⁻²⁸ The media coverage and behavior of public officials can contribute to the stress and precipitate panic or demoralization, particularly if inaccurate, confusing, or contradictory information is provided to the public. Rumors must be anticipated, monitored, and corrected with accurate information.¹⁷ Any damage to public trust at the beginning of the crisis ensures that distrust will

continue throughout the crisis. There are psychological and physiological costs attendant to the loss of trust.

For example, the handling of information by officials and the media during the release of nuclear radiation at Three Mile Island became a major source of anxiety and stress for people living in the vicinity of the nuclear facility. At Three Mile Island, there were no casualties or severely injured individuals. The stress was fear and uncertainty about exposure to excess radioactivity, loss of faith in local authorities and those managing operations of the reactor, and financial uncertainties.²⁹ Baum followed individuals at the Three Mile Island site and at 3 control sites for 10 years.²⁹ He found evidence of chronic arousal as indicated by elevated norepinephrine and epinephrine in some individuals.

CONCLUSION

Governmental and private agencies should develop detailed strategies for responding to a biological terrorist attack that include consideration of the psychological and social impact of such an attack. Inattention to the phenomenon of terror and its consequences for individuals, institutions, and society jeopardize the efficacy of disaster mitigation efforts. Leaders, scientists, and the media should develop protocols covering a broad range of

scenarios that communicate accurate information about risk and diminish rumors. These primary prevention efforts will be critical in preventing panic and demoralization in the attacked community. The possible forensic responsibilities of first responders should receive appropriate consideration when collecting data and preparing for future action that will determine responsibility for the attack.

Realistic training for biological attacks should include the probability of large numbers of psychological casualties. Training exercises should be designed to test cooperation and coordination between organizations as well as test first responders and hospital staff. Hospital accrediting bodies should encourage medical facilities to incorporate biological scenarios into their annual training.

Planning and preparation for biological attacks and their attendant psychological consequences can diminish the terrorists' ability to achieve their overall goal—the induction of terror. Education of the public and institutional preparedness can mitigate the horror of terrorism. The media could play an active prevention role by realistically educating the public about the impact of terrorist attacks with biological weapons. Such preparation efforts should be given high priority.

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Biological Terrorism

Preparing to Meet the Threat

Jeffrey D. Simon, PhD

The threat of terrorists using biological warfare agents has received increased attention in recent years. Despite the hope that, with the right mix of policies, security measures, and intelligence gathering, a major biological warfare terrorist attack can be prevented, the history of conventional terrorism indicates otherwise. The greatest payoff in combating biological terrorism lies in focusing on how best to respond to a terrorist attack. The medical and emergency service communities will play the most important role in that process. Ensuring that they are trained to recognize the symptoms of diseases caused by biological warfare agents and have Critical Incident Stress Debriefing teams available to help them cope with the emotional aspects of treating exposed survivors should be part of contingency planning. By improving our readiness to respond to biological terrorism, many lives can be saved and terrorists denied their goal of creating panic and crisis throughout the country.

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THE THREAT of terrorists using biological warfare (BW) agents has received increased attention in recent years. Congressional hearings,¹ research studies,²⁻⁵ government warnings,⁶ and commentaries^{7,8} have all pointed to a potentially more ominous terrorism future. Many factors account for this concern—revelations that Iraq, a state sponsor of terrorism, stockpiled anthrax, botulinum toxin, and other BW agents during the Persian Gulf War; the discovery that Aum Shinrikyo, the Japanese religious cult that released the chemical agent sarin in the Tokyo subway system in 1995, had a research and development program for BW agents; the low cost and minimum scientific knowledge required for producing BW agents; and the tendency for terrorists to move

into new areas of violence when current ones no longer achieve the intended effect—publicity, reaction, chaos.⁹

Despite this growing concern, however, we still know very little about the nature of BW terrorism. There has never been a major BW terrorist attack. Therefore, there is no track record of incidents, groups, tactics, motives, and targets for analysis to determine the best strategies for combatting this global threat. In this regard, we are today with respect to BW terrorism where we were nearly 30 years ago with respect to "conventional" terrorism. A new international threat was emerging then, but it was unclear as to the direction it would take.

It took several years after the first major international hijacking in 1968 for the diverse nature of conventional terrorism (hijackings, bombings, hostage situations) to become clear and for governments to take action against the threat. Biological warfare terrorism, however, will not allow governments, publics, and the international community the luxury of time to watch this

threat unfold and then determine the proper responses. Since BW terrorist attacks could have catastrophic effects in terms of lives lost and create a medical, political, and social crisis unparalleled in our history, it is important to prepare now for this new age of terrorism.

... we are today with respect to BW terrorism where we were nearly 30 years ago with respect to "conventional" terrorism.

The first step is to accept the reality that we will not be able to prevent every act of BW terrorism. Governments have learned that painful lesson with respect to conventional terrorism. While preventive measures must continue to be pursued, the greatest payoff in fighting BW terrorism lies in improving our response to an incident. There will be more opportunity for saving lives in the emergency medical response to a BW terrorist attack than in the response to a conventional terrorist attack. Whereas most of the fatalities in a conventional terrorist bombing occur immediately or shortly after the explosion,¹⁰ in BW terrorism the incubation period for the virus, bacterium, or toxin could be several days. Accurate diagnosis and speedy treatment could save many lives.

The medical and health communities will therefore play the most significant role in combatting BW terrorism, and they will have to carry out their duties at a time of unprecedented crisis and fear throughout the country. To the extent that we can reduce the uncertainty about how BW terrorist incidents are likely to

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unfold, the better the medical and health professions will be prepared to deal with the aftermath of this most dangerous form of global terrorism.

BIOLOGICAL TERRORISM: LIKELY TACTICS AND TARGETS

The most distinguishing feature separating BW terrorism from conventional terrorism is the extraordinarily larger number of casualties that could follow a major terrorist attack involving biological agents. Whereas bombings of airplanes or buildings with conventional explosives have occasionally resulted in a few hundred deaths, each act of BW terrorism could result in hundreds of thousands or even millions of casualties.² Adding to the death toll would be the fact that civilian populations are not immunized against most BW agents and do not have protective equipment, such as filtered respirators and gas masks, readily available.¹

Some biological agents have been used in the past for selective attacks. For example, Bulgarian agents assassinated Georgi Markov, a Bulgarian emigré and writer for the British Broadcasting Company, by stabbing him in London with an umbrella-type weapon that contained ricin,¹¹ which is a potent protein toxin derived from the bean of the castor plant (*Ricinus communis*).¹² (Another Bulgarian émigré, Vladimir Kostov, was attacked in a similar fashion in Paris in 1978, but lived when physicians removed the pellet containing ricin from his body.) However, a terrorist group that uses BW agents will likely be attracted to the mass killing potential of these weapons. It makes little sense for terrorists to experiment with dangerous biological agents—they could be killed handling and using them—if their goal is a limited attack that could have been achieved by using safer and more familiar conventional weapons.

Biological warfare terrorism will also encompass a narrower range of tactics than conventional terrorism. Although BW agents could be used during a hijacking or hostage situation, there would be little incentive for terrorists to do so. The projected death toll would be no higher than if conventional weapons were used. And while BW agents could be delivered against a target by means of a bomb or missile, the likelihood that the organisms will be destroyed in the explosion makes this an unattractive delivery method.²

Rather, the most likely BW terrorist tactic will be to release BW agents—anthrax spores, botulinum toxin, ricin, or other deadly agents—into the air as a biological aerosol, a stable cloud of suspended microscopic droplets of bacterial or virus particles.³ Since BW agents are invisible, odorless, and tasteless, no one would know that a terrorist attack is under way.

The aerosol release of BW agents could be accomplished in several ways, including using low-flying airplanes, crop dusters, or trucks equipped with spray tanks and releasing the BW agent upwind of populated areas; leaving aerosol canisters filled with the BW agent and timing devices in subways, airports, air-conditioning/heating systems in buildings, or other crowded places; or directly contaminating bulk food supplies in restaurants, supermarkets, or other places with a BW agent. However, large US water supplies such as a city water supply would not be an attractive target for contamination due to the large amount of BW agent required and water purification procedures used by most cities in the United States.

Since there are no reliable detection systems for BW agents, terrorists will be able to strike any target they desire. Whereas terrorists with conventional weapons have to be concerned about metal detectors, x-ray machines, and other physical security measures, terrorists with BW agents do not face those means of detection. With maximum casualties the likely goal, metropolitan areas are the most at risk. At the present time and for the foreseeable future, major cities in the United States and around the world remain indefensible to a BW terrorist attack.

RESPONDING TO BW TERRORISM: UNCHARTERED WATERS

The heightened concern regarding biological terrorism has led to studies of how well prepared the United States is to respond to a major incident. The findings are not encouraging. During hearings held in 1995 and 1996, the US Senate Permanent Subcommittee on Investigations, for example, found that the United States did not have a plan that coordinated federal, state, and local agencies in managing the consequences of a terrorist attack with a weapon of mass destruction.¹ The subcommittee also found that principal field officers with police, fire, and emergency service departments in major cities are inadequately trained and do not have basic equipment to deal with biological, chemical, or nuclear terrorism, including protective gear, breathing apparatus, decontaminants, and antidotes.^{1,13}

The lack of preparedness is attributable to several factors. One is that since the casualties from a biological terrorist incident are so disturbing even to think about, many public officials cling to the hope that with the right mix of police, security measures, and intelligence gathering, BW terrorism can be prevented. Funding for emergency responses to BW terrorism therefore has not been given the high priority it deserves until very recently. The second factor is the difficult task of plan-

ning for an event that has never occurred before. Emergency response teams are therefore left only with alternative scenarios to guide them in their plans.

An amendment to the 1997 Defense Authorization Act addresses some of these issues by calling for better training, equipment, and coordination among emergency response personnel in the United States to deal with a terrorist incident involving a weapon of mass destruction.¹⁴ There is also a need for hospitals to have adequate supplies—or ways to quickly obtain these supplies—of antibiotics and antitoxins that could be used to treat those exposed to BW agents. Medical personnel also should be trained to recognize the different symptoms of various BW agents so that those exposed can be treated quickly. Most physicians do not see cases of anthrax in their daily practices.¹

Since BW agents are invisible, odorless, and tasteless, no one would know that a terrorist attack is under way.

An important part of the response to BW terrorism will be dealing with the psychological reactions among survivors, emergency workers, and the public. Terrorism is a form of psychological warfare with terrorists often perpetrating their violence to cause fear among the public. In BW terrorism, that fear will understandably be great as people watch their fellow citizens fall ill and possibly die in large numbers due to anthrax, botulism, or other diseases. Contingency plans for dealing with public hysteria and disruption of health care delivery systems—including the possibility of health care professionals' becoming ill from the BW attack, or fleeing the affected area if they are not confident that they have adequate equipment to protect themselves—should be established in every large city.

The mental health of emergency workers and medical personnel will have to be monitored during a BW terrorism crisis. Research indicates that the most traumatic events for emergency nurses are the death of a child and the death of a coworker.¹⁵ A major BW incident will likely have many of these types of victims. Dealing with dead bodies can also cause emotional and psychological problems for disaster rescue and recovery workers.⁶ During a BW terrorist incident, rescue workers will face the unique situation of dealing with large numbers of deaths in a setting that otherwise seems very normal. There will not be any collapsed or bombed-out buildings, fires, plane crashes, and so forth. The psychological impact of that situation on first-

responders needs to be addressed in contingency plans.

The Critical Incident Stress Debriefing (CISD) process could help in dealing with the psychological aspects of a BW terrorist attack. This process is part of a broad crisis intervention program known as Critical Incident Stress Management (CISM), which is designed to prevent or mitigate the development of adverse psychological reactions among emergency service and public safety personnel, nurses, physicians, and disaster workers. The program has been used during earthquakes, plane crashes, terrorist bombings, and other tragic events. Through various psychological intervention techniques, a CISD team led by mental health professionals and including peer support personnel from the emergency services can help emergency workers and medical personnel recover as quickly as possible from the stress associated with the crisis.¹⁷

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A potential problem, however, is that some CISD and CISM teams could become a hindrance to first-responders. They might interfere with the duties of emergency service personnel, or inadvertently aggravate the emotional trauma being experienced by making incorrect assessments of mental health needs. It is therefore crucial that CISD and CISM teams be properly trained for crisis intervention services.

The military will also play an important role in the aftermath of a BW terrorist attack. They will be called on to assist federal and local authorities, just as they have helped local communities following domestic disasters such as hurricanes, floods, and earthquakes.¹⁵ But since their BW training has focused on defending against BW perpetrated by enemy troops in a battlefield setting, there will be a need to retrain them for responding to a BW terrorist attack in a civilian setting.

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CONCLUSION

Terrorists with BW agents pose a threat to this nation's—and all nations'—vital interests. In the 1960s, the physicist Herman Kahn wrote a book on fighting a nuclear war entitled *Thinking About the Unthinkable*.¹⁸ Fortunately, we never had to experience that event, and the end of the cold war hopefully means we never will. But we face a new threat at the dawn of the 21st century, and it is one that we must think about and for which we must prepare. By improving our readiness to respond to a BW terrorist attack, many lives can be saved and the terrorists denied their goal of creating panic and crisis in this country.

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Why Should We Be Concerned About Biological Warfare?

There is a widespread tendency to think about defense against biological warfare as unnecessary, as someone else's responsibility, or as simply too difficult. Unfortunately, however, the dangers posed by biological weapons did not disappear when the United States began to unilaterally dismantle its own offensive program in 1969. The dangers did not vanish with the signing of the Biological and Toxin Weapons Convention of 1972, and they did not dissipate with the end of the Cold War or the threat of nuclear retaliation against Iraq during the Persian Gulf conflict. Only by planning and investing in the right training and defensive measures can we diminish the likelihood that biological weapons will be used and reduce the risks, disruption, and casualties in the event that such weapons are used.¹ Fortunately, significant improvements can be made in our defensive posture at relatively modest levels of investment, and both the Department of Defense and the medical community can play a substantial role in this regard.

Biological weapons are unfortunately characterized by low visibility, high potency, substantial accessibility, and relatively easy delivery. The basic facts are well known: a millionth of a gram of anthrax constitutes a lethal inhalation dose. A kilogram, depending on meteorological conditions and means of delivery, has the potential to kill hundreds of thousands of people in a metropolitan area. These small quantities make the concealment, transportation, and dissemination of biological agents relatively easy. Many of these agents—bacteria, viruses, and toxins—occur naturally in the environment. Moreover, many are used for wholly legitimate medical purposes (such as the development of antibiotics and vaccines), and much of the technology required to produce and “weaponize” them is available for civilian or military use. Unlike nuclear weapons, missiles or other advanced systems are not required for the delivery of biological weapons. Since aerosolization is the predominant method of dissemination, extraordinarily low-technology methods, including agricultural crop dusters, backpack sprayers, and even purse-size perfume atomizers will suffice. Small groups of people with modest finances and basic training in biology and engineering can develop an effective biological weapons capability. Recipes for making biological weapons are even available on the Internet.

These unique characteristics make both military and civilian society vulnerable to biological weapons. It is true that

their delayed effects and vulnerability to weather make these weapons ill-suited to military purposes such as seizing territory. But biological weapons can effectively impede the mobilization and massing of troops that would be required to sustain our role in a conventional conflict. Most disturbingly, they can be used to threaten civilian populations and create mass panic. Used this way, biological weapons can achieve military goals by undercutting the civilian support necessary for military operations or by holding civilians hostage to prevent military operations.

Why Have Biological Weapons Been Low on Our Agenda?

If biological weapons are so potent and so cheap, if the technology is readily available, and if so many of our adversaries have biological warfare capabilities, then why has this issue been so low on our national security agenda?

There are 3 principal reasons. First, because defense against a biological attack is both unfamiliar and difficult, there is a natural tendency to put it aside in favor of problems that are more comfortable. This is abetted by a second factor: the belief that because biological weapons have never been used they therefore never will be. And this is in turn buttressed by a sense that a regime can be deterred from using biological weaponry if we make it clear that this would invite nuclear retaliation.

These modes of thought are dangerously inappropriate. If we address deterrence first, many argue that Saddam Hussein's unwillingness to unleash Iraq's biological arsenal, in the face of not-so subtle threats of nuclear retaliation, validates the primacy of our deterrent. However, nations are not the only potential users of biological weapons. If one of the most likely scenarios entails their use by nonstate actors, small groups, or even individuals, a nuclear deterrent may be ineffective. Of course, terrorists can often be associated with state sponsors, but the quantum of proof we would require before responding to such a perceived linkage with a nuclear attack would be awfully high. Consider, for example, the forensic difficulty in assigning responsibility for the tragic attack against Pan Am Flight 103 that exploded over Lockerbie, Scotland, in 1988. In the event of a biological contingency, it is especially easy to mask the nature and source of an attack and even to obscure whether it is a natural occurrence. In such circumstances, can we credibly rely on a threat of assured nuclear retaliation? Depending on the agent used, if those exposed just got sick but did not die, what would constitute a proportional response?

The assumption that biological weapons will not be used in the future because they have not been used in the past is based on an error of fact. History is replete with examples in which biological weapons have been used, including the following²: in the Middle Ages infected cadavers were catapulted over the walls of European cities and castles under siege; in

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the French and Indian Wars, the British supplied Indians with smallpox-infected blankets; during World War II, Japanese Unit 731 experimented with biological weapons on prisoners of war in Manchuria, resulting in more than 1000 deaths.

There are also abundant examples that bring the threat much closer to home. In 1995, 2 members of a Minnesota militia group were convicted of possession of ricin, which they had produced themselves for use in retaliation against local government officials.^{3,4} In 1996, an Ohio man with connections to an extremist group was able to obtain bubonic plague cultures through the postal service.³ It has even come to light that Aum Shinrikyo, the Japanese cult organization responsible for the sarin attacks on the Tokyo subway system, was working on anthrax and botulism as weapons.⁵ The group's biological capability, its production and testing and laboratory infrastructure, and its experimental delivery systems existed for years while escaping detection by Western intelligence.

While it is often said that familiarity breeds contempt, no national security establishment can let unfamiliarity breed neglect. Biology is unfamiliar terrain. As Alan Beyerchen, PhD, has pointed out, the history of the absorption of technology into the war fighting capabilities of the Department of Defense suggests a reason for this blind spot.⁶ World War I brought chemists and war fighters together; World War II brought physicists into the fold; and the cold war represented an era of the primacy of the computing, telecommunications, and electronics communities in the defense arena. What little connection the US government maintained with the biological community dissipated when, in 1969, we foreswore any offensive biological and toxin weapon capability. But our forbearance does not imply that of others. The United Nations' inspections of Iraq after the Persian Gulf conflict should be a wake-up call in this regard.⁷ Along with the information of a high-level defector who had responsibility for Iraq's unconventional weapons program, these inspections revealed a large-scale biological production and "weaponization" effort that had gone substantially undetected by the West.

What Should We Do About the Threat of Biological Warfare?

The Department of Defense has embarked on a challenging program to enhance its capabilities to defend against biological warfare. The program includes, among other things, the development and fielding of state-of-the-art biodetectors; the creation and designation of selected military units with expertise in medical prophylaxis, hazard mitigation, and decontamination; investments in vaccine and antibiotic research, development, and stockpiling; refinement and acquisition of masks and improvements in air filtration systems to preclude infection via inhalation; improved intelligence collection and analysis; enhanced training; and the development of doctrine regarding how to preempt and, when necessary, respond to a biological attack.

An additional critical element of this program, however, is the need for an enhanced relationship between the military and those agencies charged with protecting the civilian population of the United States. In that regard, biological weapons necessarily alter our strategic thinking about national security and the nature of warfare. Wars may not always be fought on set-piece traditional battlefields, and it is time to throw away the anachronistic notion that the military's only role is to defend the United States against threats on foreign soil.

In the event of a domestic incident of biological weapons use, no matter who the perpetrator, it is unlikely that the response would be left to local law enforcement and health

officials or even to the Federal Bureau of Investigation, the Federal Emergency Management Agency, or the US Public Health Service. The military would undoubtedly be called on because of its resources, capabilities, and expertise. At the same time, if a biological incident were to occur in a military context, the Department of Defense would look to and need the help of such civilian agencies as the Centers for Disease Control and Prevention (CDC).

Although achieving it is one of our greatest challenges, an enhanced cooperation between military and civilian institutions is also likely to pay big dividends. In some respects the Atlanta Olympics were a good case in point, and the multi-agency partnerships that spanned federal, state, and local jurisdictions will serve as a model for future response.⁸ Not only were the Olympics a model of cooperation, but they also marked a milestone for our response capabilities. In the immediate aftermath of the Centennial Park pipe-bomb explosion, bomb fragments were analyzed by Department of Defense assets—set up at a temporary laboratory at the CDC headquarters—to detect the presence of chemical or biological agents; none was found. This marked the first time that a domestic explosive had been routinely screened for those agents.

To facilitate and enhance this civil-military cooperation, Congress recently enacted the Defense Against Weapons of Mass Destruction Act of 1996, which seeks to enhance our domestic preparedness in several fundamental ways, including the following: by strengthening the federal government's ability to prevent and respond to terrorist incidents involving weapons of mass destruction; by enabling the Department of Defense and other federal supports to state and local prevention and response efforts; and by improving the capabilities of state and local emergency responders themselves. More than 100 cities in the United States have already been designated under the provisions of this legislation; their fire, police, rescue, and hospital emergency department personnel will receive training and equipment in an ambitious program conducted by the Department of Defense that began this summer.⁹

From another vantage point, the good news wrapped inside the particular problems posed by biological weapons is that in this arena, public health is the best form of civil defense. Our everyday domestic investments to detect and diagnose disease can and should be strengthened because of our national security trends. Biological weapons are not respectful of traditional boundaries of geography, bureaucracy, or conceptual compartmentalization. In that fact lies our challenge, our opportunity, and our call to action.

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Botulism Surveillance and Emergency Response

A Public Health Strategy for a Global Challenge

Botulism is a neuroparalytic disease caused by a neurotoxin produced from an anaerobic spore-forming bacterium known as *Clostridium botulinum*.¹ The lethal potency of this toxin has mandated intensive surveillance and control measures in the United States. Recent outbreaks of botulism have raised questions regarding the international supply and therapeutic use of botulism antitoxin, and reports that national governments² and terrorist groups³ have stockpiled botulism toxin have increased levels of concern regarding global preparedness for an intentional episode of botulism poisoning. It is estimated that as little as 1 g of aerosolized botulism toxin has the potential to kill at least 1.5 million people, and modern techniques of aerosolization via tactical ballistic missiles or aeronautical spraying may be capable of disseminating up to 60% of this dosage to a target population.⁴

A description of the clinical features of aerosolized botulism toxin poisoning appears elsewhere in this issue.⁵ Herein, we describe the US Botulism Surveillance System. The implementation of a similar system on a global scale would (1) establish a more efficient system for detection and diagnosis of the disease, (2) ensure a coordinated and effective public health response to future outbreaks of foodborne botulism, (3) provide a mechanism for distribution of antitoxin in the event of an intentional poisoning, and (4) provide data regarding the epidemiology of botulism that could prevent future cases.

Botulism Surveillance

The Centers for Disease Control and Prevention (CDC) maintain intensive surveillance for cases of botulism in the United States. To identify possible outbreaks of botulism as rapidly as possible, CDC provides epidemiologic consultation and laboratory diagnostic services to state and local health departments in suspected noninfant botulism cases. Physicians are encouraged to contact their state epidemiologists as soon as they suspect a patient may have botulism. State epidemiology offices maintain emergency contact numbers and have been provided with detailed CDC guidelines on diagnosis, management, and prevention of botulism. Epidemiologists from the Foodborne and Diarrheal Diseases Branch are avail-

able 24 hours a day to answer calls from state and local health departments or physicians treating potential cases of botulism (emergency number: [404] 639-2888). In concert with state epidemiology offices, CDC epidemiologists recommend appropriate laboratory testing (performed either at CDC or in state laboratories) and ancillary studies to either confirm or rule out the diagnosis. Local public health authorities and national food safety authorities are involved from the beginning, to investigate possible sources and determine the need for further investigation and preventive measures.

Physicians are encouraged to contact their state epidemiologists as soon as they suspect a patient may have botulism.

When foodborne, wound, or adult infectious botulism is suspected, antitoxin is released from CDC quarantine stations located in airports in New York, Chicago, Atlanta, Miami, Los Angeles, San Francisco, Seattle, and Honolulu. The states of California and Alaska control the release of botulism antitoxin independently of CDC, because of the relatively large number of botulism cases in those states and the need for local storage of antitoxin in isolated areas of Alaska. In most cases in the United States, antitoxin is administered to the patient within 12 hours of the decision to release the product (CDC, unpublished data). All data regarding antitoxin releases and laboratory confirmation of cases (including Alaska and California) are recorded annually by CDC. Because CDC is the only source of botulism antitoxin administered in the United States, nearly all diagnosed cases of botulism are reported. The rapid investigation of cases by local health officials and CDC prevents additional cases of botulism from implicated foods.

International Provision of Antitoxin

The CDC has an agreement with the Pan American Health Organization (PAHO) to supply botulism antitoxin to other countries in the Western Hemisphere, with the exception of Canada, which maintains its own supply. Antitoxin is released by CDC for cases of suspected botulism in other nations in the Western Hemisphere, after consultation with regional physicians and in collaboration with PAHO. The cost of this program is absorbed by PAHO from funds provided by each country. This system ensures a coordinated release program for

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the entire hemisphere and allows CDC to maintain some surveillance of botulism outbreaks throughout the Americas. In 1995, CDC released 14 vials of antitoxin in collaboration with PAHO for use in Mexico and Argentina.

Sources of Antitoxin

The US surveillance and antitoxin release program depends on the maintenance of a sufficient supply of antitoxin. This is ensured through a contract with Connaught Laboratories Ltd, Willowdale, Ontario, which is one of the few suppliers of trivalent equine antitoxin worldwide. The CDC contracts for a guaranteed supply of antitoxin each year, and the amount ordered varies minimally from year to year. In addition, CDC has an agreement with the US Army to release antitoxin kept by the army for use in emergency situations such as a terrorist attack with botulism toxin.

In contrast to the Western Hemisphere, there is no reliable source of antitoxin elsewhere in the world. Botulism antitoxin production takes approximately 2 years because of the complicated process of immunizing and then collecting serum from horses, although excess product can be freeze-dried and stored indefinitely for future use. Other than Connaught Laboratories Ltd, we know of only 3 suppliers of botulism antitoxin (although no information is available regarding production in the countries of the former Soviet Union or in China). Of the 3 known suppliers, 1 company does not supply antitoxin outside of Japan and the 2 European suppliers maintain limited quantities and have recently suffered from shortages because of unanticipated demand. Because there is no consistent purchase of antitoxin by governments other than the United States, Canada, and Japan, international suppliers need to estimate demand for their product on a year-to-year basis. This unpredictable demand, coupled with a complex production process, has driven several suppliers out of the market in recent years.

Responding to the Threat of Biological Warfare

As many as 17 countries are suspected of either including or developing biological agents in their offensive weapons programs³; botulism toxin is frequently one of these agents because it is relatively easy to produce and highly lethal in small quantities. To date, there have been no reported intentional botulism toxin poisonings in the world. However, in August 1995, Iraq revealed that during the Persian Gulf War 11 200 L of botulism toxin preparation were loaded into specially designed SCUD missile warheads.² These warheads were specifically designed for the delivery of biological agents. The Aum Shinrikyo cult in Japan also produced botulism toxin before its 1995 terrorist attack on the Tokyo subway system, although it used the nerve agent sarin in the attack.⁶ Instructions for the production of botulism toxin have been broadcast on the Internet as well. In the event of large-scale biological warfare using botulism toxin, a likely route of poisoning would be through an atmospheric explosion or aircraft spraying that releases aerosolized particles of toxin (most likely type A), which are approximately 0.1 to 0.3 μm .⁴ Although foodborne or waterborne routes are also possible, these are less effective vehicles for large-scale terrorism or warfare. If an attack is suspected, the exposure can be either avoided or averted through cooking, because cooking destroys the toxin. Botulism toxin is naturally inactivated in fresh water in 3 to 6 days; chlorinated water supplies inactivate toxin within 20 min-

utes.^{7,8} However, because foodborne and waterborne poisonings avoid the need for technically sophisticated explosive devices or aerial spraying, these enteric routes of transmission remain a significant threat for terrorist attacks on a smaller scale.

In contrast to the Western Hemisphere, there is no reliable source of antitoxin elsewhere in the world.

Supportive care through the rapid mobilization of mechanical ventilators would be the primary means of caring for patients exposed to either an aerosolized or large-scale enteric botulism toxin exposure. The rapid administration of botulism antitoxin is the only pharmacologic treatment available; antitoxin administration is effective in preventing progression of illness and in shortening the duration of ventilatory failure in severe cases of botulism if given early in the course of neurologic dysfunction.⁹ In US Army experiments, equine F(ab')₂ botulism antitoxin given therapeutically to rhesus monkeys as late as 24 hours after an aerosol challenge with a lethal dose of type A toxin provided high levels of survival.⁴ However, without mechanical ventilation, the toxin was uniformly lethal if antitoxin administration was delayed until clinical signs had occurred, which was between 29 and 46 hours from exposure in these experiments.⁴ Prophylactic immunization with a vaccine against botulism toxin also would be protective against an exposure to botulism toxin.¹⁰ However, the botulism toxoid vaccine is an unlicensed vaccine, and the immunization process would need to begin months in advance of an exposure. It does not provide lifelong immunity, and administration is impractical outside of a select high-risk group (eg, laboratory workers who work with botulism specimens or military personnel with risk of exposure in battlefield conditions).

Creating a Network

Countries outside of the Western Hemisphere may be unprepared for either a foodborne outbreak or a botulism terrorism attack since there is no coordinated system for antitoxin release. Recent foodborne botulism outbreaks in Egypt,¹¹ Italy,¹² Austria, and Turkey (CDC, unpublished records, 1996) have demonstrated the need for a coordinated antitoxin release system and have exposed shortages in the available European supply. The United States only releases antitoxin internationally through its contract with PAHO, since this contract ensures an efficient, coordinated release process and a relatively predictable demand. Because of long flight times, it is unrealistic to supply other parts of the world on an emergency basis from stocks in the Western Hemisphere.

A program similar to the US Botulism Surveillance System could be adopted elsewhere in the world, with antitoxin release stations in several geographic regions. An ideal system would have multinational funding and be coordinated through an international organization or a participating group of nations. In such a program, 3 to 5 botulism antitoxin release sites would be designated throughout the world, creating a network that would also provide laboratory and technical support for each region. All nations would know where to call regionally for emergency assistance and that a source of antitoxin was always available for cases that met diagnostic criteria.

Such a program would improve international surveillance for botulism cases and serve as an early warning system for either a foodborne outbreak or an intentional botulism terrorist attack. While the current international shortage of available antitoxin would limit the effectiveness of such a release program in the event of a large outbreak or attack, this should not preclude the establishment of an organized system for antitoxin release. Such a framework can increase the supply of antitoxin by helping to establish the predictable demand that is necessary to boost production by pharmaceutical companies. Additional benefits of an international network for antitoxin release would also include the dissemination of surveillance information among countries; improved accuracy in the determination of international antitoxin production requirements; and the coordination of medical and epidemiologic assistance following a terrorist attack or large foodborne outbreak, including emergency donations of equipment (eg, endotracheal tubes and hand-operated ventilation equipment).

Conclusion

The US Botulism Surveillance System, with its accompanying antitoxin release program, is an effective way of managing this rare but deadly disease in the United States and the Western Hemisphere. The program ensures intensive surveillance via an adequate supply of antitoxin coupled with an efficient release mechanism. Recently reported botulism outbreaks in Europe and the Middle East and the potential for an international terrorist attack using botulism toxin suggest that a similar strategy would be of benefit elsewhere in the

world as well. Such a system could provide for efficient botulism surveillance and antitoxin release throughout the world and would serve as a framework to build on in a potential crisis situation.

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Editorial

Editorials represent the opinions of the authors and THE JOURNAL and not those of the American Medical Association.

Infectious Disease and Biological Weapons Prophylaxis and Mitigation

The topic of biological warfare (BW) was last covered systematically by *JAMA*, as part of a discourse on weapons of mass destruction, in August 1989.^{1,3} That year marked the bicentennials of the French Revolution and the start of the American presidency. By year's end, 1989 also marked the collapse of the Soviet Empire, and with that the end of the cold war. The Biological Weapons Convention (BWC) had been in place since 1972; nevertheless, compliance on the part of great states, notably Russia, with that convention was the centerpiece anxiety in 1989. United States national policy was likewise concentrated on the defense of our troops in tactical combat settings.

Medical interests, notably symbolized by the World Health Organization's pleas⁴ had played a significant role in the diplomatic priority given to the BWC, and then to concern for its enforcement. Since 1989, the Persian Gulf War, the escalation of terrorism, and a recrudescence of many infections have added new dimensions to concerns for the malicious incitement of disease. Iraq was proven to have developed and militarized a rep-

ertoire of BW agents, notably anthrax spores.⁵ Terrorists achieved new levels of violence in New York, Oklahoma City, and Tokyo—and operated on ever more incomprehensible and unpredictable rationales. Having deployed chemical weapons in Tokyo and dabbled in BW, terrorists would soon be attempting to deploy BW on an increasing scale. It is not difficult to find recipes for home-brew botulinum toxin on the World Wide Web; terrorists justify this with the proposition that every citizen should have the parity of power with government. Meanwhile, the growth of biotechnology has great promise for new modes of diagnosis and therapy, but if left unchecked, advances in biotechnology will allow for even more troublesome microbiological agents of destruction.

This theme issue of *JAMA* then touches on a set of timely concerns that unite national security and public health, concerns that cry out for well-articulated convergence of the human community worldwide. Various articles in this issue touch on the historical,⁶ diplomatic,^{7,8} and legal background⁹; on mo-

dalities of diagnosis and management^{10,11}; and on case studies of small-scale BW attacks that have already been perpetrated, though amateurish in design and ending with limited malefaction.^{12,13} The needs and interests of physicians have been uppermost in the selection of articles to publish from among many excellent submissions for this issue. The medical community does indeed have a primary role in institutionalizing the prohibition of BW as a global commandment, as well as in mitigating the harm from infractions. How else can BW be described than as the absolute perversion of medical science?

The problematics of invoking humanitarian regulation of means of warfare are well understood.^{14,15} Resort to warfare is tied to the use of any means necessary for the survival of the state, including organized violence. It is mainly the peacetime behavior of states that can be regulated by international law, and this has evolved toward greater coherence and impact in an interdependent global economy. Even in the thrall of violent combat, states will also be deterred when there is a firm international resolve: Iraq did not, after all, use its massive stockpiles of anthrax.⁵ Physicians can help drive home the understanding that the habitual practice of BW would be ruinous, undermining personal security and civil order far more grievously than any other weapon likely to get in the hands of disgruntled individuals or rogue states. One sine qua non for the elimination of BW is its utter delegitimation; in the language of the Geneva Protocol of 1925, it must be "justly condemned by the general opinion of the civilized world."¹⁶

As a matter of international law, any debate has already been settled by the wide adoption of the 1972 BWC. The abnegation of biological weapons is approaching the status of a norm of international behavior, going beyond a mere contract for mutual compliance. When an international consensus can be achieved and sustained, as happened after Iraq's invasion of Kuwait, severe sanctions can be imposed by the international community. The task is to build that moral consensus¹⁷ and give it sustainability and priority over more transient aspects of perceived national interest, like commercial advantage or access to resources. We are happily less burdened by the choosing up of sides of the cold war and the strange bedfellows that process engendered. There is much to answer for in the nonchalance exhibited by most of the world when Iraq used chemical weapons in its wars against Iran and its own Kurd dissidents.¹⁸

Scrupulous adherence to the BWC on our own side, coming to the bar with clean hands, is of course an absolute prerequisite to the moral platform of BW prohibition. There is no more powerful instrument for that credibility than factually competent self-inspection.

... physicians in every country should insist on being empowered to scrutinize suspicious occurrences and facilities and to investigate outbreaks.

With regard to infectious disease and microbiologic agents, physicians in every country should insist on being empowered to scrutinize suspicious occurrences and facilities and to investigate outbreaks. I do not suggest that every physician be mandated to snoop into every commercial or governmental facility, but every physician should be free to ask for evidence of the kind of intermediating oversight that will provide assurance of legitimacy. Such machinery already governs the protection of

research subjects and of environmental safety. Knowledge that Russian physicians were freely and actively engaging their own government and military on the disposition of cold war-era BW facilities would be far more reassuring than any formal system of verification by transnational inspection (and its absence correspondingly alarming). Revival of trust will be further promoted by initiatives for joint cooperative research and public health programs, particularly in infectious disease, some of which are beginning to be emplaced.

Finally, physicians will be in the front line for remediation in the wake of BW attack. They should be alert to any constellation of disease that might be the harbinger of new outbreaks. This issue of THE JOURNAL includes an invaluable primer¹⁰ on the most likely exotic agents, otherwise hardly expected to be within the ken of most physicians. In the United States, individual clinicians would of course funnel their reports to local and state public health offices, and in turn to the national Centers for Disease Control and Prevention (Emergency Response Coordination Group, telephone [770] 488-7100).

Besides their personal contribution, physicians are in the best position to assess the readiness of local health services, police, and firefighter first-responders to deal with health emergencies. This is the same apparatus needed to deal with natural disease outbreaks—recall *Legionella* and *Escherichia coli* O157:H7 of recent vintage. The local responders also need to be trained in exercises entailing support from the Public Health Service and, if need be, military personnel. Several articles in this issue point to recent progress, and a long way still to go, in the coordination of resources among a host of US governmental agencies—federal, state, and local.^{11,19} In view of the rapid dispersal of people via jet aircraft, that coordination needs to be extended to a global venue, and this scarcely exists at all at the present time.

Joshua Lederberg, PhD

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Smiling Beef Club

**The President of the United States
William Jefferson Clinton**

Honorary Member No. 1

A handwritten signature in black ink, appearing to read "Diego Ramiro Guelar". The signature is stylized with a large, sweeping initial "D" and "R".

**Diego Ramiro Guelar
Ambassador**

THE WHITE HOUSE
WASHINGTON

May 26, 1998

H.E. Diego Ramiro Guelar
Embassy of Argentina
1600 New Hampshire Avenue, NW
Washington, DC 20009

Dear Diego:

What a wonderful host you are, and how delightful the initial meeting of your "Smiling Beef Club" was. I was honored to be Honorary Member Numero Dos and, of course, the President feels the same way about his being Honorary Member Numero Uno.

Your very kind words about me in your presentation were appreciated and, indeed, touched me. You are such a diplomat and you have been a good friend, and I am grateful for both relationships. You represent Argentina in an exemplary, dignified, and effective manner, and I look forward to working with you in the days ahead and after I leave government in June. Your Smiling Beef Club evening was just one more example of the Diego Guelar touch. The members of the press clearly enjoyed themselves, as did your guests, and I thought *The Washington Post Style* section commentary was quite positive.

Donna joins me in sending our warmest regards to you and Diana.

Personally,

5-28-98

U. U. U. f

Phil -

Should we send to Burkhardt
for reply?

Don/Delia Yes
Place advice no
Phil

bcc: Eric
~~P-663~~

Carol -
To Staff Secretary -
Could you make
sure attached
card gets to
right person for
preparation of
thank you
letter from
POTUS - P
THANKS,

