NAVAL GUN DEVELOPMENT JUST BEFORE & AFTER 1900

BY FRANK J. GADEK, PH.D., FAIC

MANY DETAILS PROVIDED FOR PROPER:

CONTEXT

PERSPECTIVE

HUMAN / SOCIETAL ASPECTS

EXPLORATION OF THIS & RELATED TOPICS FROM THE PAST CAN SUBSTANTIALLY ASSIST IN BETTER UNDERSTANDING & APPRECIATING THE DRAMATIC & CONTINUAL POWERFUL EFFECTS IN OUR CURRENT & FUTURE EXPANDING GLOBAL PERSPECTIVE OF:

SCIENCE, TECHNOLOGY & SOCIETY [STS]

THIS PRESENTATION IS AN ATTEMPT TO PRESENT IN "LAYMAN'S" SIMPLE TERMS SOME VERY COMPLEX ASPECTS OF THIS TOPIC, SO THAT A BETTER GENERAL UNDERSTANDING & APPRECIATION CAN BE OBTAINED

MUCH FURTHER READING & RESEARVH IS HIGHLY ENCOURAGED TO MORE FULLY INCREASE THE UNDERSTANDING & APPRECIATION OF THIS & RELATED TOPICS

FORTUNATELY, MANY GOOD REFERENCES & WEB SITES ARE AVAILABLE FOR SUCH COMPLEX & DETAILED INFORMATION

AS CHURCHILL SAID – THE FIRST CASUALTY OF WAR IS THE TRUTH!

HE ALSO SAID THAT WAR IS A HECTIC RACE THAT DOES NOT DIMINISH UNTIL RESOLUTION IS OBTAINED

IN ADDITION, DUE TO THE VERY FAST PACED & HECTIC NATURE OF WARTIME, THERE CAN BE MUCH MISINFORMATION & LACK OF ESSENTIAL INFORMATION

THEREFORE, TO ATTEMPT TO GET MORE THAN A GENERAL "FEELING" OF A TOPIC, A GREAT DEAL OF MUCH MORE SOPHISTICATED & INTENSIVE RESEARCH IS REQUIRED

CHURCHILL

^ AS A "NON-SCIENCE MAJOR / PERSON"
[SCIENCE PHOBIC??? – HIS "ISSUES" WITH VARIOUS MATHMATICAL AREAS!!!]
WAS UNUSUALY ABLE TO APPRECIATE TO A HIGH DEGREE THE BASIC SIGNIFICANCE OF A SCIENTIFIC DEVELOPMENT & HOW IT MIGHT DRASTICALLY IMPACT ON THE ACTIONS OF THE COUNTRY TO WIN THE WAR

^ HE WAS OBVIOUSLY NOT PERFECT

^ BUT HE WAS OBVIOUSLY VERY PERCEPTIVE IN WHAT WAS NECESSARY "STS" WISE FOR SUCCESS, ESPECIALLY IN MANY MATTERS DEALING WITH SCIENCE & WAR

GUNPOWDER & EXPLOSIVES

SMOKELESS GUNPOWDER A SIGNIFICANT DEVELOPMENT

SOLVENT "ACETONE" NEEDED

WEIZMANN HAD PROCESS FROM AGRICULTURAL PRODUCTS TO MAKE ACETONE IN LARGE AMOUNTS

TOPIC FURTHER DEVELOPED IN ANOTHER PRESENTATION

SUPERIOR TO OLDER / MORE COMMON BLACK POWDER

COMPLETE COMBUSTION INTO GASES
BURNS CLEANLY
GIVES OFF LITTLE SMOKE
CAN CLOSELY CONTROL SPEED OF BURNING
CAN BE STORED FOR LONG TIME
GIVES UNIFORM RESULTS
HURLS PROJECTILE WITH CONSIDERABLE GREATER FORCE

VERY SIMPLY:

SINCE MORE FORCE IS GENERATED

PROJECTILES CAN BE BIGGER

RANGE & ACCURACY INCREASED

RIFLING OF GUN BARREL RATHER THAN SMOOTH BORE, ALSO ASSISTED RANGE & ACCURACY

SO DRAMATIC CHANGES IN STRATEGY & TACTICS HAD TO BE CONSIDERED

THEREFORE, MUCH DEBATE ENSUED & MANY NEW IDEAS WERE TRIED

LIVES & HISTORY WAS AT STAKE

HOWEVER, ONLY RESULTS OF ACTUAL BATTLES COULD REALLY DETERMINE WHAT MIGHT BE THE BEST COURSE OF ACTION

SCIENCE PROVIDED NEW THEORIES

TECHNOLOGY PUT THESE NEW THEORIES INTO NEW PRACTICAL USES

SOCIETY WAS DRAMATICALLY CHANGED TO ATTEMPT TO BETTER MANAGE COMPLEX RESULTS [*MANY UNEXPECTED*] OF THESE NEW SCIENCE & TECHNOLOGY DEVELOPMENTS

PREVIOUSLY WOODEN SAILING SHIPS BOMBARDED EACH OTHER AT CLOSE RANGE [YARDS] WITH BROADSIDES OF CANNON SHOT FROM SMOOTH BORE GUNS

> BLACK POWDER CREATED LOT OF SMOKE

> BUT WOODEN SHIPS RARELY SANK

> RAMMING WAS USED TO DAMAGE & TRY TO SINK WOODEN SHIPS

> ***SPEED WAS SLOW***

AFTER BOMBARDMENT, OBJECT WAS TO BOARD EACH OTHER & WITH HAND TO HAND FIGHTING TRY TO WIN THE BATTLE [E.G. NELSON AT TRAFALGAR]

AT DEFEAT OF SPANISH ARMADA 1588 BY BRITAIN

EVEN SINGLE SHIP WITH DETERMINED CREW COULD BE POUNDED ALL DAY BY NAVAL GUNS & STILL BE AFLOAT

TO DO ANY LETHAL DAMAGE TO 120 SPANISH SHIPS WOULD NEED MORE AMMUNITION THAN EVER EXISTED IN ALL OF ENGLAND & WOULD TAKE WEEKS

[P#101, "THE PURSUIT OF POWER," WILLIAM H. MCNEILL]
P#167, "BRITISH SEA POWER: HOW BRITAIN BECAME SOVEREIGN OF THE SEAS," DAVID HOWARTH]

BRITISH EVEN EVENTUALLY RAN OUT OF AMMUNITION, ALSO NEEDED FOOD & WATER

BRITISH HAD OUTRUN THEIR OWN RESOURCES

P#172, "BRITISH SEA POWER: HOW BRITAIN BECAME SOVEREIGN OF THE SEAS," DAVID HOWARTH]

COULD NOT SINK SPANISH ARMADA, BUT A STORM DID

[P#101, "THE PURSUIT OF POWER," WILLIAM H. MCNEILL]

SHELLS USING NEW SMOKELESS GUNPOWDER & RIFLED GUNS

- < COULD GO STRAIGHT THRU WOODEN SHIPS
- < MORE DAMAGE COULD RESULT
- < RANGE & ACCURACY COULD BE MUCH GREATER SO BATTLES COULD BE FOUGHT AT GREATER DISTANCES

LESS NEED FOR RAMMING

IN CONJUNCTION WITH CONVERSION TO MORE PREDICTABLE & POWERFUL STEAM – COAL & OIL, & NOT JUST MORE UNPREDICTABLE SAIL POWER, GOT INCREASED SPEED, MANUVERABILITY, TIMING OF ATTACK, COORDINATION OF SHIPS, ETC.

PROTECTION AGAINST THESE NEW MORE POWERFUL GUNS / SHELLS OF WOODEN SHIPS WAS THEN DEVELOPED

IRON PLATES ADDED OVER WOOD BUT MADE SHIPS HEAVIER & LESS SPEED / MANUEVERABILITY, ESPECIALLY UNDER SAIL ONLY, SO COAL / OIL POWER BECAME MANDATORY

SUCH SHIPS COULD MORE EASILY SINK COMPARED TO WOODEN SHIPS

STEEL SHIPS DEVELOPED WITH SPECIAL HARDENED STEEL – **ARMOUR** – ADDED AT CERTAIN CRITICAL POINTS

WATERTIGHT COMPARTMENTS COULD NOW BE BUILT WITH NEW STEEL SHIPS IN ORDER TO ASSIST IN MINIMIZING SINKING IF HIT BY SHEELS

SHELLS DEVELOPED WITH NEW EXPLOSIVES TO DAMAGE BOTH OUTSIDE & INSIDE SHIPS THAT ARE HIT

ALL THESE FACTORS GREATLY INCREASED THE COMPLEXITY & TIME TO BUILD SUCH SHIPS, GUNS & SHELLS

MUCH PRACTICAL "TRIAL & ERROR" INVOLVED, ESPECIALLY SINCE COMPUTERS NOT INVENTED YET!

1822 GENERAL HENRI J. PAIXHANS

WROTE BOOK "NOUVELLE FORCE MARITIME"

ARGUED ARMOR PLATED SHIPS WITH LARGE CALIBER GUNS CAPABLE OF FIRING EXPLOSIVE SHELLS COULD DESTROY WOODEN SHIPS WITH COMPLETE IMPUNITY

HE JUST DEVELOPED SUCH A SHELL GUN

TESTS 1824 SHOWED CLAIMS WELL FOUNDED

FRENCH ADOPTED HIS NEW SHELL 1837 & BRITISH 1838

[P#226, "THE PURSUIT OF POWER," WILLIAM H. MCNEILL]

1853 BATTLE OF SINOPE RUSSIAN FLEET USING NEW SHELLS DESTROYED TURKISH FLEET

[P#226, "THE PURSUIT OF POWER," WILLIAM H. MCNEILL]

SO GUNS / SHELLS BECAME ***MUCH LARGER***

FOR DREADNOUGHT, NEW LARGE ALL ONE GUN SHIP, 12” GUNS / SHELLS WERE SPECIFIED ON TURRETS

BROADSIDE COULD STILL BE FIRED BUT WITH USING ALL TURRETED GUNS POINTING IN ONE DIRECTION

EVEN LARGER GUNS / SHELLS SOON FOLLOWED

DESTRUCTIVE POWER OF NEW LARGER GUNS / SHELLS WAS ***VERY DRAMATIC***

"CONTEST" **DEVELOPED BETWEEN EVER LARGER GUNS & EVER GREATER ARMOUR**

WEIGHT OF THESE GUNS & ARMOUR CREATED

"*ANOTHER CONTEST*" OF MORE POWERFUL ENGINES & DESIGN OF SHIPS TO TRY TO MAINTAIN & EVEN INCREASE SPEED

OF THE 3 – GUNS, ARMOUR & SPEED – PRACTICALLY COULD ONLY MAXIMIZE ANY 2, BUT NOT THE THIRD – SO MANY COMPLEX "TRADEOFFS" DEVELOPED

APPROPRIATE COMPROMISE THE KEY!

VERY SIMPLY:

BRITISH FAVORED GUNS & SPEED, SO

- **LESS ARMOUR**
- **SHIPS MORE SPACIOUS SINCE LIVED**
  - **ON THEM EXTENDED PERIODS**
  - **MAINTAINING EXTENDED BRITISH EMPIRE**

GERMANS FAVORED GUNS & ARMOUR,

- **SO LESS SPEED**
- **SHIPS MADE VERY STRONG**
  - **BUT COULD BE MORE CRAMPED**
  - **SINCE DID NOT LIVE ON THEM**
  - **FOR EXTENDED PERIODS, ONLY**
  - **ON THEM FOR SPECIFIC MISSIONS**

[TOPIC DEVELOPED IN MORE DETAIL IN ANOTHER PRESENTATION]

VERY SERIOUS

LIVES, COUNTRIES

& HISTORY

AT STAKE

REQUIRED MANY RADICAL

"NEW WAYS OF THINKING"

DEVELOPMENT

OF EVER LARGER

GUNS / SHELLS

SOME VERY DRAMATIC, PRACTICAL & REAL RESULTS OBTAINED FROM BATTLE OF TSUSHIMA 1904 DURING RUSSO-JAPANESE WAR

LARGER, UNIFORM ARMAMENT MORE EFFECTIVE

FIRING AT 7000 YARDS [ABOUT 4 MILES]

BRITISH OBSERVER ON JAPANESE SHIP CAPTAIN PAKENHAM:
WHEN 12” GUNS FIRED, 10” GUNS PASS UNNOTICED, 8” & 6” GUNS MIGHT AS WELL BE PEASHOOTERS!
[P#471, MASSIE, “DREADNOUGHT”]

BUT MANY DIRECTLY RELATED SERIOUS ISSUES DEVELOPED:

HOW TO COMMUNICATE WITH
LARGER FLEETS OVER
LONG DISTANCES OF BATTLE
E.G., FLAGS, SIGNAL LIGHTS,
RADIO JUST STARTING

FIRE CONTROL OF GUNS AT LONGER
DISTANCES & COORDINATION
WITH OTHER SHIPS

AVAILABILITY OF SUFFICIENT COAL / OIL
WHEN & WHERE NEEDED

ETC.

IN ERA OF "ONLY SAIL":

^ ALL SAILED WITH WIND
^ NO WIND, NO TRAVEL
^ GREATER WIND, GREATER SPEED,
^ BUT VERY UNPREDICTABLE
^ VERY STRONG WINDS COULD DESTROY SHIPS
^ ALL BATTLE PLANS HAD TO CONSIDER WIND
^ GREAT SKILL NEEDED TO GET MAXIMUM USE OF WIND POWER ON SHIPS
^ NO REFULING NEEDS REQUIRED
^ ETC.

DREADNOUGHT ALMOST RAN OUT OF COAL ON FIRST VOYAGE

STEAMING NONSTOP FOR 10 DAYS IN ATLANTIC, ARRIVED AT SPITHEAD DOWN TO LAST 18 TONS OF COAL – ENOUGH FOR ONLY 4 MORE HOURS SAILING!!!

ABOUT 900 TONS OF COAL CARRIED [1]

[18 / 900 = 2% & 90 TONS / DAY OF SAILING CONSUMED]

[P#483, MASSIE, "DREADNOUGHT"]

[1] **[P#11, ROBERTS, "THE BATTLESHIP DREADNOUGHT"]**

NOTE:

SOLID COAL HAD TO BE HAND SHOVELED INTO BOILERS TO MAKE STEAM & POWER – HUNDREDS OF MEN ["STOKERS"] DID THIS IN EXCESSIVE HEAT OF THE BOILER ROOMS

LOADING COAL ONTO SHIPS COULD ALSO BE RESOURCE INTENSIVE - MEN, TIME, ETC.

LIQUID OIL COULD BE PUMPED TO BOILERS TO MAKE POWER – BUT MORE FLAMMABLE – MUCH LESS LABOR INTENSIVE

MANY OF THESE CRITICAL RELATED TOPICS DEVELOPED IN GREATER DETAIL IN OTHER PRESENTATIONS

DEMONSTRATION OF 12” GUNS FIRING:

IN LESS THAN 3 MINUTES, 12 ROUNDS FIRED
6 BY EACH OF 2 TURRETS
2 GUNS / TURRET SO 1 ROUND / MINUTE
FIRED BY EACH GUN

TARGETS – 2 FLOATING CANVAS STRUCTURES
14’ X 14’, ONLY 1.5 MILES AWAY SO ALL
COULD SEE DAMAGE

OF 12 ROUNDS – 11 HIT TARGET, 9 BULL’S EYES

2 TURRETS MANNED BY ONLY REGULAR GUN CREWS!
[P#484, MASSIE, “DREADNOUGHT”]

ONCE RANGE OBTAINED:

FISHER ESTIMATED

EACH 12” GUN FIRED 1 SHELL / MINUTE

6 GUNS [ONLY 3 OF 4 TURRETS ON DREADNOUGHT,
2 GUNS / TURRET] WITH 50% HITS AT
6000 YARDS [ABOUT 3 MILES]

RESULT – 3 - 12” SHELLS WITH HUGH BURSTING
CHARGES WOULD HIT ON BOARD
EVERY MINUTE!!! – WOULD BE HELL!!!

[P#472, MASSIE, “DREADNOUGHT”]

IN 1907 TARGET PRACTICE

SCORED 25 HITS IN 40 ROUNDS FIRED [62%]
AT 8000 YARDS [ABOUT 4 MILES]
RANKED 3RD IN FLEET
BUT WEIGHT OF SHELL THROWN AT
TARGET RANKED UNCHALLENGED
SUPREME
A CRUCIAL FACTOR IN BATTLE
IN 8 MINUTES HURLED 21,250 POUNDS
[ABOUT 10 TONS] OF SHELLS
75 % MORE THAN ANY OTHER BRITISH
BATTLESHIP

[P#488, MASSIE, "DREADNOUGHT"]

SPEED

GERMAN OCEAN LINERS – "BLUE WATER GREYHOUNDS OF GERMAN LLOYD & HAMBURG-AMERICAN LINES

CONSTRUCTED TO CARRY 6" GUNS

DESIGNED TO WISK PASSENGERS ACROSS NORTH ATLANTIC IN 5 – 6 DAYS [REFER TO TITANIC???]

COULD EASILY OUTRUN ANY EXISITING BRITISH CRUISER!!!

[P#493, MASSIE, "DREADNOUGHT"]

QUICK ACCURATE GUNNERY + SOME LUCK

12” SHELL INTO PROPULSION SPACES OR POWDER MAGAZINE WOULD END BATTLE SUDDENLY!

[E.G. HMS HOOD ISSUE]

[P#495, MASSIE, “DREADNOUGHT”]

BUT AT JUTLAND:

BEATTY DECIDED TO LEAD "CALVARY CHARGE" AT GERMAN SHIPS [ME – OLD, CAVALERISH ATTITUDES – THE NELSON TRAFALGAR GOALS OF PAST ERAS]

INSTEAD OF USING SPEED TO STAY OUT OF RANGE OF GERMAN BATTLESHIPS & BIG GUNS

DISASTEROUS RESULTS!

[P#496-7, MASSIE, "DREADNOUGHT"]

ESTIMATE ["RULE OF THUMB"] DAMAGE EFFECT OF SHELL SIZE

F. GADEK, 08/22/2005

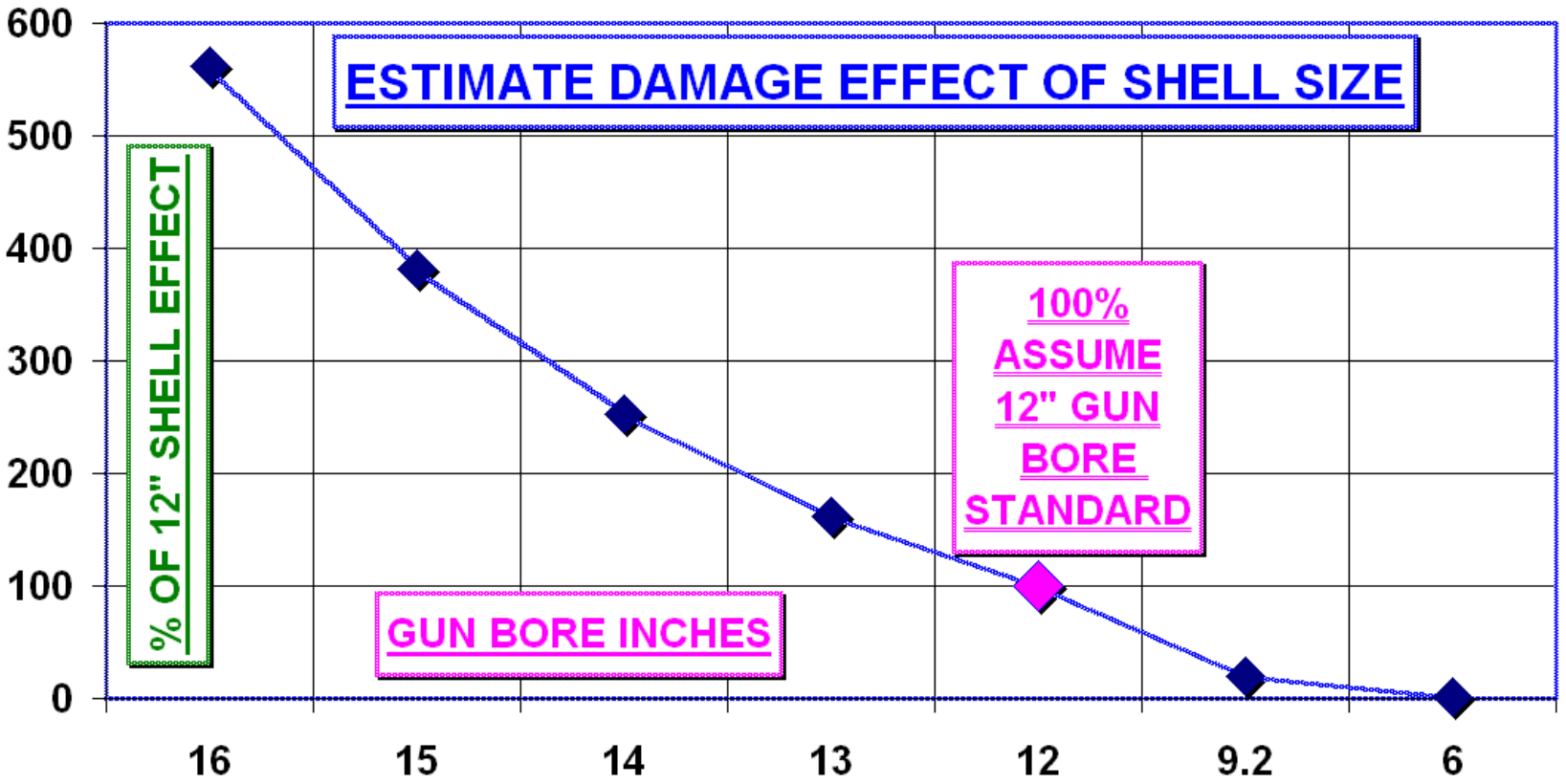
GUN BORE INCHES	BURSTING CHARGE [CUBE BORE]	EFFECT SHEEL DAMAGE [SQUARE BURSTING CHARGE]	% OF 12" SHELL EFFECT
16	4096	16777216	562
15	3375	11390625	381
14	2744	7529536	252
13	2197	4826809	162
12	**1728**	**2985984**	**100**
9.2	779	606355	20
6	216	46656	2

REFERENCE:

P#193 "THE GRAND FLEET: WARSHIP DESIGN & DEVELOPMENT 1906 - 1922, D. K. BROWN

NOTES:

TAKE **12" GUN BORE** AS STANDARD FOR COMPARISON



HOWEVER, QUEST FOR EVER LARGER GUNS / SHELLS STARTED TO TEST THE PHYSICAL ENDURANCE LIMITS OF THE SHIPS & HUMANS

16” SHELLS STARTED TO DAMAGE SHIPS

GUN CREW STARTED TO EXPERIENCE “RED FLASHES” IN THEIR EYES WHEN GUNS FIRED DUE TO CONCUSSIVE EFFECTS OF EXPLOSION OF PROPELLANT

HOWEVER, EFFECT OF FULL BROADSIDE FIRING OF ALL 8 – 12” GUNS AT ONCE ON THE DREADNOUGHT WAS NOT KNOWN

WITH MUCH TREPEDATION, SIR PHILIP WATTS, THE DREADNOUGHT DESIGNER, WAS PRESENT WHEN THE FIRST FIRING OCCURRED & TO HIS RELIEF, THERE WAS A MUFFLED ROAR & A BIT OF A KICK ON THE SHIP, BUT MANY MEN BELOW DECK HAD NO IDEA WHAT HAPPENED!!!

[P#482 , MASSIE, “DREADNOUGHT”]

1914 15” GUNS ON BRITISH BATTLECRUISERS WITH 32 KNOTS SPEED [REPULSE & RENOWN SHIPS]

PLANS FOR 18” GUNS & 35 KNOTS SPEED [FURIOUS, FISHER’S ULTIMATE BATTLECRUISER!!!]

20” GUNS IN DESIGN STAGE WHILE FISHER AT ADMIRALTY

[P#121, 317, HOUGH, “THE GREAT WAR AT SEA 1914 – 1918]

STS – CAN BE VERY SEDUCTIVE – ALMOST LIKE GETTING INTOXICATED, UNTIL REALITY EVENTUALLY STRIKES

LIMITS OF STS EVENTUALLY REACHED

CHURCHILL

FOUND OUT THAT FOR 25 KNOTS & 15” GUNS NEEDED DISPLACEMENT OF 27,500 TONS – SO OIL & NOT COAL WAS REQUIRED

BUT BRITAIN HAD VERY LITTLE OIL, BUT PLENTY OF COAL

[P#27, HOUGH, “THE GREAT WAR AT SEA 1914 – 1918]

DEVELOPMENT OF EVER MORE

POWERFUL & DIFFERENT

EXPLOSIVES / PROPELLANTS

SOME AMERICAN PROPELLANTS

SOME INFORMATION FROM BOOK: "ELEMENTARY NAVAL ORDNANCE AND GUNNERY" BY LIEUTENANT H. C. RAMSEY, 1918

SCANS OF CHAPTER X BY C. F. MOORE ON WWW.GWPDA.ORG/NAVAL/GUNPX01.HTM

GIVES SOME VALUABLE INSIGHTS OF THE THINKING, KNOWLEDGE & PRACTICAL USE OF THAT TIME PERIOD

EXPLOVSIVES USED IN US NAVAL SERVICE

3 CLASSES

1] PROGRESSIVE OR PROPELLING

LOW EXPLOSIVES

SMOKELESS POWDER

ALL GUNPOWDERS

PROPELS PROJECTILE BY GAS

SLOW & PROGRESSIVE

2] DISRUPTIVE OR DETONATING

HIGH EXPLOSIVES

QUICKER IN ACTION

DISRUPTIVE IN EXPLOSION –

BREAKS UP / FRAGMENTS

CONTAINER

3] EXPLODERS OR DETONATORS

FULMINATES – E.G. MERCURY

VERY FAST IN ACTION – ALMOST INSTANTANEOUS

ORIGINATE EXPLOSIVE REACTIONS FOR OTHER CLASSES OF EXPLOSIVES

BUT SCANS NOT COMPLETE,

SO SOME INFORMATION LOST

GUNPOWDER – PROGRESSIVE / PROPELLING

BLACK POWDER – INTENSE COAL BLACK COLOR
- ONLY SMALL GRAINED NOW USED
- MIXTURECARBON, POTASSIUM NITRATE & SULPHUR
- QUICKER ACTING THAN SMOKELESS POWDER SO USED TO IGNITE SMOKELESS POWDER
- NOT USED NOW AS PROPELLING CHARGE

BROWN POWDER – WAS USED EXTENSIVELY, BUT NO
- LONGER ISSUED
- UNDER BURNED CHARCOAL MADE BETTER EXPLOSIVE [1]
- IMPORTANT IN SPANISH-AMERICAN WAR [1]

[1] [P#54, "EXPLOSIVES IN HISTORY," NORMAN B. WILKINSON, THE HAGLEY MUSEUM, 1966]

1898 SPANISH-AMERICAN WAR – APRIL TO DECEMBER

CRITICAL SHORTAGE OF POWDER FOR LARGE NAVAL GUNS, ARTILLERY & RIFLES IN USA

SINCE AFTER CIVIL WAR, EXPLOSIVES INDUSTRY CONCENTRATED ON MAKING BLACK POWDER & DYNAMITE FOR CONTRUCTION & OTHER INDUSTRIAL USES

NEW SMOKELESS POWDER SHOWN COULD BE USED IN LARGE CALIBER GUNS

BUT POWDER COMPANIES COULD NOT YET MAKE LARGE QUANTITIES FOR WAR NEEDS & IT WOULD TAKE ABOUT A YEAR TO MEET DEMAND

SO WAR FOUGHT WITH BLACK POWDER USED FOR CENTURIES

BUT IMPROVED FOR MILITARY USE & CALLED **"BROWN OR COCOA"** POWDER DUE TO COLOR & SHAPE OF GRAINS

[P#53-4, "EXPLOSIVES IN HISTORY," NORMAN B. WILKINSON, THE HAGLEY MUSEUM, 1966]

BROWN POWDER DEVELOPED BY FRENCH, BELGIAN & GERMANS WHO FOUND UNDERBURNED CHARCOAL MADE A BETTER EXPLOSIVE THAN CUSTOMARY BLACK CHARCOAL

MOST EFFECTIVE IN LARGE GUNS & GAVE BETTER RESULTS THAN BLACK POWDER

ONLY CALIFORNIA POWDER WORKS & DU PONT OF DELAWARE MADE IT IN USA

DU PONT HAD BEEN MAKING ABOUT 3000 POUNDS / DAY BUT GOVERNMENT ASKED FOR 25,000 POUNDS / DAY!!!

SO DU PONT STOPPED MAKING OTHER POWDERS & ONLY MADE "COCOA POWDER"

GOVERNMENT ESTIMATED IT WOULD NEED 5 MILLION POUNDS "ASAP" – PRICE WAS $0.32 / LB – IN TODAY'S DOLLARS THIS WOULD BE XXXXX????

P#53-4, "EXPLOSIVES IN HISTORY," NORMAN B. WILKINSON, THE HAGLEY MUSEUM, 1966]

DAILY PRODUCTION REACHED 25,000 POUNDS / DAY DURING MAY AND BY END OF WAR 2 MILLION POUNDS HAD BEEN DELIVERED

MUCH WENT TO NAVY FOR THEIR BIG GUNS & WAR WAS ALMOST AN ENTIRELY NAVAL WAR

BUT WAR ENDED ABRUPTLY, SO GOVERNMENT HAD ENORMOUS SURPLUSES & CONTRACTS QUICKLY CANCELLED

LAST WAR SIZABLE AMOUNTS OF BLACK POWDER OR "COCOA POWDER" USED

WW I 1914 – 1918 USED WHOLLY DIFFERENT TYPES OF EXPLOSIVES – SMOKELESS POWDER, GUNCOTTON & TNT [TRINITROTOLUENE]
ONLY ABOUT 11 MILLION POUNDS OF BLACK POWDER MANUFACTURED & USED MOSTLY AS A PRIMER FOR SMOKELESS POWDER, FUSES & SHRAPNEL SHELLS
[P#53-5, "EXPLOSIVES IN HISTORY," NORMAN B. WILKINSON, THE HAGLEY MUSEUM, 1966]

SMOKELESS POWDER:

DEVELOPMED MORE FULLY IN ANOTHER PRESENTATION

BRIEFLY –

FOUND 1830'S
1845 BECAME WIDELY KNOWN
1886 SCHULZE USED IT IN SHOTGUNS
& VIEILLE IN RIFLES CALLED "POUDRE B"

SUPERIOR TO BLACK POWDER

COMPLETE COMBUSTION INTO GASES
BURNS CLEANLY
GIVES OFF LITTLE SMOKE
CAN CLOSELY CONTROL SPEED OF BURNING
CAN BE STORED FOR LONG TIME
GIVES UNIFORM RESULTS
HURLS PROJECTILE WITH CONSIDERABLE
GREATER FORCE

[P#53-8, "EXPLOSIVES IN HISTORY," NORMAN B. WILKINSON, THE HAGLEY MUSEUM, 1966]

LARGEST PRODUCER DUPONT
BY 1918 MADE 455 MILLION POUNDS!

BUT NEW EXPLOSIVES DEVELOPED:

1846 ITALIAN SOBRERO & NITROGLYCERINE

1866 SWEDISH NOBEL & DYNAMITE [NITROGLYCERINE + OTHER INGREDIENTS]

1866 GEORGE MOWBRAY THE PIONEER MANUFACTURER OF NITROGLYCERINE, BUILT SMALL FACTORY NEAR TITUSVILLE, PA [1]

1920'S REPAUNO CHEMICAL COMPANY OF NJ & OF DU PONT WORLD'S LARGEST PRODUCER OF DYNAMITE

1924 DYNAMITE FAR OUTSTRIPPED OLDER EXPLOSIVES, 273 MILLION POUNDS USED IN USA VS 167 MILLION POUNDS OF BLACK POWDER

PANAMA CANAL CONSUMED 61 MILLION POUNDS OF DYNAMITE!!!

[P#53-61, "EXPLOSIVES IN HISTORY," NORMAN B. WILKINSON, THE HAGLEY MUSEUM, 1966]

[1] [P#6, "EXPLOSVIES DEVELOPMENT AND USE," DUPONT A-60299]

1900 ONLY 2 BLACK POWDER PLANTS OF MODEST SIZE
STILL EXISTED IN PA & OH
BLACK POWDER STILL USED IN SOME MINING, QUARRYING, FIREWORKS, TO START SOME AIRPLANE ENGINES & MUZZLE-LOADING RIFLES – A FEW ISOLATED COUNTRIES STILL USE IT IN MILITARY

OF COURSE 1940'S USHERED IN A NEW FORM OF EXPLOSIVE & MUCH MORE POWERFUL – ATOMIC ENERGY
[P#60, "EXPLOSIVES IN HISTORY," NORMAN B. WILKINSON, THE HAGLEY MUSEUM, 1966]

COLOR VARIES FROM LIGHT LEMON TO DARK BROWN & ALMOST BLACK & DEPENDS ON SLIGHT VARIATIONS OF MANUFACTURING PROCESS
GRAIN IS HARD & TOUGH & TRANSLUCENT – LIKE STICK OF LEMON CANDY – SOME GRAINS DYED RED

COMPOSITION – "GUN-COTTON" OR NITRO-CELLULOSE – MADE BY NITRATING CELLULOSE – DIFFERENT GRADES HAVE DIFFERENT LEVELS OF NITRATION
[SCANS OF CHAPTER X, BY C. F. MOORE ON WWW.GWPDA.ORG/NAVAL/GUNPX01.HTM]

CAN BE SHAPED UNDER PRESSURE & WILL NOT DETONATE / EXPLODE

GRAIN WILL BURN REGULARLY WITHOUT SMOKE

MANUFACTURING PROCESS INVOLVES MANY STEPS & CAN TAKE MANY MONTHS

WILL IGNITE 180 DEGRESS C – MUCH LOWER THAN BLACK POWDER

WHITE CLOUD FORMED IS NOT SMOKE BUT GASES PROPELLING PROJECTILE OUT OF GUN

BLACK POWDER – ESTIMATED 65% FORMS BLACK SMOKE & RESIDUE TO CLOG RIFLING – ONLY 35% CONVERTED TO GASES TO EXPEL PROJECTILE

3 DISTINCT PROGRESSIVE ACTIONS OF GUNPOWDER

IGNITION – FULMINATE OF MERCURY CAP IGNITES PRIMER WHICH IGNITES MAIN CHARGE OF POWDER

INFLAMMATION – SPREADING OF IGNITION OVER & THRU MAIN CHARGE OF POWDER – VELOCITY OF INFLAMATION IS TIME NEEDED FOR INFLAMMATION OF WHOLE POWDER CHARGE

COMBUSTION – CONSUMING OR CONVERSION TO GAS OF EACH GRAIN OF POWDER

EXPLOSIVES USED IN US NAVAL SERVICE

3 CLASSES

1] **PROGRESSIVE OR PROPELLING**
LOW EXPLOSIVES

2] **DISRUPTIVE OR DETONATING**
HIGH EXPLOSIVES

3] **EXPLODERS OR DETONATORS**
FULMINATES – E.G. MERCURY
VERY FAST IN ACTION – ALMOST INSTANTANEOUS

SECOND OF 3 CLASSES OF EXPLOSIVES:

DETONATING OR DISTRIBUTIVE – USED FOR BURSTING CHARGES IN PROJECTILES & TORPEDOES, MINES & DEMOLITION OF STRUCTURES

TYPES:

1] DUNNITE [EXPLOSIVE "D"]
2] GUN COTTON
3] TRINITROTOLUOL [TNT]
4] PICRIC ACID
5] NITROGLYCERINE
6] DYNAMITE

FIRST 3 ONLY ONES USED FOR NAVAL PURPOSES TO ANY GREAT EXTENT

PICRIC ACID – NOT USED AS MUCH –

IGNITION DOES NOT PROGRESS FIRST OVER THE SURFACE OF THE CHARGE

BUT EXPLOSIVE REACTIONS ALMOST INSTANTANEOUS & PROGRESS RADIALLY IN ALL DIRECTIONS THROUGHOUT MASS OF THE CHARGE

SO TRANSFORMATION FROM SOLID TO GAS TIME VERY SHORT

EXPLOSIVE "D" OR DUNNITE

- NAME DERIVED FROM INVENTOR
- DEEP YELLOW FINE GRAIN
- A DERIVATIVE OF PICRIC ACID

TRINITROTOLUOL OR "TNT"

- COMPARATIVELY NEW EXPLOSIVE
  - IN NAVAL SERVICE & RAPIDLY
  - COMING INTO EXTENSIVE USE
- FORMS OF GRAINS, COMPRESSED,
  - MOLTEN OR CAST
- LIGHT CREAM, WHITE OR PALE YELLOW
- DETONATED BY ELECTRIC OR PERCUSSION
  - PRIMER
- REPLACING WET GUN COTTON
- NOT SUSCEPTIBLE TO WATER SO CAN BE
  - USED IN WATER MINES

GUN-COTTON:

LIKE SMOKELESS POWDER, BUT

HIGHER DEGREE OF NITRATION

> 13.2 % NITROGEN

FOR SMOKELESS POWDER:

THIRD DEGREE OF NITRATION

> 12.75% NITRATION

SECOND DEGREE OF NITRATION

12 – 12.75 % NITRATION

FIRST DEGREE OF NITRATION

????? – MAY NOT BE OF SUFFICIENT STRENGTH

3 CHIEF TYPES OF CELLULOSE NITRATE PRODUCED

1] CELLULOID PYROXYLIN – CONTAINS 10.5 – 11% NITROGEN

2] SOULBLE PYROXYLIN [COLLODION COTTON, DYNAMITE COTTON – CONTAINS 11.5 – 12.3 % NITROGEN

3] GUNCOTTON – 12.5 – 13.5% NITROGEN – SOLUBLE IN ACETONE BUT NOT ETHANOL-ETHER OR ABSOLUTE [100%] ETHANOL, LIKE OTHER 2 TYPES – SO SPECIAL NEED FOR ACETONE

DINITRATES OF CELLULOSE CONTAIN 11.11% NITROGEN

TRINITRATES OF CELLULOSE CONTAIN 14.5% NITROGEN

SO COMMERCIAL PRODUCTS ARE MIXTURES OF THE DI & TRI NITRATES

GUNCOTTON LEAST DEGRADED – CHAIN LENGTH ABOUT 3000 C6 UNITS – FORM VERY VISCOUS SOLUTIONS

CELLUOID PYROXYLIN MORE DEGRADED – CHAIN LENTHS OF ONLY 500 – 600 C6 UNITS - SO LESS VISCOSITY SOLUTIONS & CAN BE USED AS LACQUER PAINTS & USED TO REPLACE VARNISH FOR AUTO PAINTS IN 1924 & REVOLUTIONIZED INDUSTRY

P#342-3, "TEXTBOOK OF ORGANIC CHEMISTRY,"NOELLER]

WET GUN COTTON – 25% BY WEIGHT PURE DISTILLED WATER ADDED

WET & DRY EQUALLY POWERFUL, BUT DRY IS EXTREMELY SENSITIVE & MORE LIABLE TO DECOMPOSITION

WET CAN ONLY BE DETONATED BY DRY GUN COTTON

DRY GUN COTTON EXPLODED BY FULMINATE OF MERCURY

SINCE DRY IS SO SENSITIVE, NOT CARRIED IN QUANTITIES ON SHIPS & ONLY CARRIED IN PRIMERS FOR WET CHARGE

WET NEEDS TO BE FREQUENTLY INSPECTED & KEPT WET TO 25% WATER FOR SAFETY

WET GUN COTTON USED FOR MINES & WRECKING CHARGES SINCE IMPERVIOUS TO WATER BUT BEING REPLACED BY TNT WHICH ALSO HAS THIS PROPERTY

2 GENERAL CLASSES OF EXPLOSIVES: NOT INTERCHANGEABLE

INDUSTRIAL / COMMERCIAL – FOR BLASTING
- MILITARY EXPLOSIVES TOO WEAK FOR MANY TYPES OF ROCK IN MINING / QUARRIES & FUMES TOXIC & UNSAFE IN MINES, BESIDES MUCH MORE EXPENSIVE UNDER NORMAL CONDITIONS

MILITARY / SPORTING – FOR GUNS
- BLACK POWDER SMOKE ON FIRING CAN GIVE AWAY POSITION
- DYNAMITE CAN'T BE USED AS PROPELLANT SINCE
  - HIGH SPEED OF DETONATION WOULD SHATTER THE GUN
  - CAN'T BE USED AS BURSTING CHARGE IN SHELLS SINCE SHOCK OF SHOOTING SHELL WOULD SET OFF THE DYNAMITE & DESTROY GUN
  - MANY GRADES BULLET SENSITIVE SO CANNOT BE USED FOR MILITARY DEMOLITION CHARGES
  - SMOKELESS POWDER & TNT [TRINITROTOLUENE] NOT SUBJECT TO THESE CRITICISMS

[P#3, "EXPLOSVIES DEVELOPMENT AND USE," DUPONT A-60299]

+SO YOU CAN SEE JUST HOW COMPLEX ALL OF THIS CAN BE

CERTAINLY A MUCH MORE DETIALED & SPECIFIC POWERPOINT PRESENTATION IS REQUIRED.

SO STAY TUNED !

LET YOUR INTERESTS & DESIRES KNOWN SO CAN BE MUCH MORE SPECIFICALLY TARGETED !

ALL BEST ALWAYS ALL YOU ALL DO FOR SO MANY IN SO MANY WAYS !

TO BE CONTINUED AS

INTEREST &

RESOURCES PERMIT

JUST LET ME KNOW !