INTERNATIONAL STATISTICAL CONGRESS AT BERLIN.

V. SESSION. FROM THE 6TH TO THE 12TH SEPTEMBER 1863.

ON THE

MILITARY STATISTICS

OF THE

UNITED STATES OF AMERICA

BY

E. B. ELLIOTT, M. A.,

FELLOW OF THE AMERICAN ACADEMY OF ARTS AND SCIENCES.
ACTUARY TO THE UNITED STATES SANITARY COMMISSION, AND DELEGATE
FROM THE AMERICAN STATISTICAL ASSOCIATION.

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TO

HIS EXCELLENCY

THE MINISTER OF THE UNITED STATES OF AMERICA,

AT BERLIN, PRUSSIA,

HON. NORMAN B. JUDD,

BERLIN, PRUSSIA,
1863.

WITH HIGHEST RESPECTS

THE AUTHOR.

CONTENTS.

On the

Military Statistics

of the United States of America*),

especially those which relate to the Mortality, the Sickness, and other Casualties, and to certain Physiological Characteristics of the Soldiers in the existing Volunteer service.

Character of Official Records and Returns.

The several bureaus in the Department of War for the United States possess and are accumulating valuable records respecting the constitution of the Army, both as to men and *matériel*, but the Department has instituted, as yet, no general system for a statistical analysis and digest of the information which its records furnish. In the bureau of the Surgeon-General, however, important changes have of late been made in the forms for the record of facts pertaining to the medical and surgical history of the war, and the records in that bureau are now made the subject of elaborate examination and discussion. To the bureau of the Adjutant-General very complete returns of the *status* and *movement* (or changes) of the Army are made periodically by commanding officers of regiments and of the companies composing them, through the commanders of Brigades, Divisions, Army-Corps, and military Departments, but no consolidation of such returns, adequate for statistical purposes, is as yet required of these commanders. Certain Consolidations of regimental returns are made »tri-monthly«, i. e. on the tenth, twentieth, and last days of each month, by the corps and departmental commanders to the bureau of the Adjutant-General, but these consolidated abstracts, although stating the aggregate amount of gain or of loss to their respective commands for the interval of time elapsing since their last previous returns, do not sufficiently specify the nature of such gain or loss; — as whether Gain from enlistments, re-enlistments, transfer, by returned of missing, etc.; or Loss from death by wounds or disease, from expiration of service, discharge from service (for disability or other cause), transfer, missing in action, desertion etc.

To obtain a knowledge of these important particulars now, requires a special examination of each of the very large number of monthly returns made by the several regiments of which the Army is composed, or of the much larger number of similar returns which are made once in every two months by the several companies composing such regiments (ten companies to each regiment). Copies of these last mentioned

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*) Several of the principal tables in this memoir were prepared at Washington, D. C., under the general direction of the Sanitary Commission, and immediate supervision of the Author, previous to the meeting of the International Statistical Congress at Berlin, in September 1863.

These tables have been carefully revised, others constructed and added, and the memoir itself, mainly written and completed in Berlin, subsequent to the session of that Congress. In its preparation, in addition to other facilities, free access to the very valuable library of the Royal Statistical Bureau in Berlin has been afforded to the Author, by the High Privy Councillor, Dr. Engel, the Director of the Bureau and President of the late Statistical Congress, through which several important facts regarding the state of European Armies have been obtained. It is to be regretted that, up to this time the collection of facts of this kind respecting armies is very limited.

returns are also filed in the bureau of the Paymaster-General, for the use of the paymasters of regiments, — payments to the Army being made, as a rule, once every two months.

A slight additional expenditure of time and labor, on the part of officers charged with the duty of making the returns, would enable the President (as Commander-in-Chief of the military and naval forces), the Secretary of War, the General-in-Chief, and the Commanding Officers of various grades, to be informed, frequently and regularly, not merely, as now, of the aggregate gains and losses of the forces under their respective commands, but also of their specific nature, as indicated above. Had such consolidated returns been made from the commencement of the present War, less difficulty would be experienced in ascertaining what has become of the forces from time to time mustered into the service and sent into the field.

Within a few months a partial but important improvement has been made in the forms for the consolidated returns above-mentioned*). Previous to November 30th, 1862, such returns, while stating the number of soldiers absent from their regiments, did not specify, with sufficient detail, the cause of absence, — as, whether absent on sick-leave, on service detached from the general command, on furlough, etc. In later returns the cause is specified. Hence, among other important facts, the proportion of soldiers sick in the army and in its several divisions and subdivisions, both absent and present, may now be determined with frequency and regularity.

Subjects proposed for consideration. — Previous publications on the Statistics of the War.

It is now proposed to call attention briefly to certain general conclusions respecting (I) Mortality and Sickness and other Casualties of the volunteer forces of the United States, derived — as the result of investigations conducted by the Sanitary Commission — mainly from an examination of the monthly regimental records above-mentioned in the bureau of the Adjutant-General; and also to certain facts respecting (II) the Physiological Characteristics of the soldiers constituting such forces, derived in part from examination of the descriptive rolls of recruits filed in the same Bureau**), and partly from original investigations, instituted by the Sanitary Commission and still in progress.

The number of monthly returns from which were derived the results herewith presented, respecting mortality and other casualties (although comprising all on file at the time of making the investigation), is far from complete — many regiments having neglected to make such returns. The proportionate neglect was greater in the early part of the war. Returns obviously defective have been rejected.

In an elaborate Official »Report to the Secretary of War on the operations of the Sanitary Commission, and upon the Sanitary Condition of the Volunteer Army, its medical staff, hospitals, and hospital supplies«, dated December 9th 1861 (Sanitary Commission Document, No. 40), in addition to other matters of importance, statistical statements, more or less complete, are given, in respect not only to the rates of sickness and mortality, and the experience of field and general hospitals as to the duration of sickness and the specific nature of the diseases prevailing (the Zymotic class comprising from two-thirds to three-fourths of all the diseases), but also, to the condition of the volunteer forces in other respects, — as, for example, in the thoroughness of the inspection of the soldiers on enlistment; the situation, arrangement and policing of camp-grounds; their drainage; the character and accommodation of tents; their ventilation; the quality and sufficiency of clothing and of food; the cooking; company and hospital funds; personal cleanliness; discipline; recreations; remittances of pay by soldiers to their homes; qualifications of surgeons; supplies for camp hospitals; ambulances, etc. — and notes of a statistical character respecting the battles near Manassas, in July 1861.

A paper, by the present writer, on the Mortality, Sickness and other Casualties of the National volunteer soldiers for the nine months early in the war (June 1861 to February 1862, inclusive) has

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*) At the suggestion of Brigadier-General Seth Williams, Assistant Adjutant-General, United States Army.

**) For facilities granted in the examination of the rolls deposited with the Department of War, acknowledgements are due to the Hon. Edwin M. Stanton, Secretary of War; to Brigadier-General Thomas, Adjutant-General, and to Assistant Adjutants-General, Colonel Townsend, the late lamented Lieutenant-Colonel Garesché and Major Breck.

since been published. (Sanitary Commission Document, No. 46.) In the present communication the results of six months additional experience on these points are given (March to August, 1862, inclusive), covering, in conjunction with the former, a period of fifteen months. Several months later information, extending to the first of April 1863, with regard to Sickness in the Army of the Potomac, derived from consolidated returns in the office of the Adjutant-General, is now also presented.

I. Mortality and other Casualties.

Of the whole force returned in the monthly reports of Strength and Casualties of volunteer regiments, for the nine months above-mentioned early in the war, filed with the Adjutant-General, sixty-four per cent. were from the regiments recruited from the Eastern portions of the loyal States, and the remaining thirty-six per cent. from the Western districts; for the next six months fifty-one per cent. of the force returned was Eastern, leaving forty-nine per cent. Western.

General Rates of Mortality of Volunteer Forces. — Fifteen months experience.

According to these records the general rate of Mortality experienced by the volunteer regiments of the Army for the complete period of fifteen months above-mentioned — estimated allowance being made for augmentation of force in the latter part of the period — was about 72 per annum to 1 000 average numerical strength; 20 from killed in action or dying of wounds received therein, and 52 from disease and accidents.

Comparison of the Mortality of the Nine Earlier and Six Later Months of the same period, distinguishing causes of death, localities whence recruited, and rank.

From comparison of the results for the nine earlier months of the war, already published, with those for the subsequent six months — reduced, in all cases, to the basis of a *year* as the unit of time — it appears that the rates of mortality have been increasing both from disease and violence, with officers and with men, in the Eastern as well as in the Western regiments.

The rate of increase from Violence, however, has been much greater than from Disease:

Thus, with respect to the troops belonging to regiments supplied by the Eastern portion of the Union, and who generally serve at the East, the mortality from Wounds has advanced from the annual rate of four (3,8) per 1 000 in the former period to twenty-eight (27,9) in the latter — an increase of six-fold; whereas from Disease the advance has been from the annual rate of twenty-eight (27,8) to that of thirty-eight (38,2) per 1 000, an increase of but about one-third. The rate from All Causes (wounds and disease combined) has advanced from thirty-two (31,6) to sixty-six (66,1), the latter rate being about double the former.

With the Western troops the annual rate from wounds and injuries received in action has advanced from eighteen (18,2) per 1 000 in the former period to thirty-nine (38,6) in the latter, this last-mentioned rate being somewhat more than double the other; the rate from disease advanced from seventy-seven (76,8) to eighty-two (81,7), an increase of not quite one tenth the former rate. From all causes (both disease and violence) the Western rates advanced from ninety-five (95,0) to one hundred and twenty (120,3) per 1 000, an increase nearly equal to one-third of the former rate.

Hence it also appears that in the East the proportionate increase has been greater than in the West, although the mortality of the latter still much exceeds the former.

For these Eastern and Western forces combined, the annual rates of mortality from wounds and injuries have advanced from nine (8,6) per 1 000 in the former period, to thirty-three (33,2) in the latter, the increase being nearly three times the former rate; from disease the advanee was from forty-four (44,6) to sixty (59,7) per 1 000, an inerease equal to one-third of the former rate. From all causes the advance has been from fifty-three (53,1) to ninety-three (92,9) per 1 000, an inerease equal to three-fourths the former rate.

The inerease of mortality, also, has been greater with Offieers than with the Men — the rate of increase having been more than two-thirds greater with the Eastern officers, and nearly one-half greater with the Western.

Comparison of the Mortality of Officers and of Men, distinguishing by periods, causes and locality.

The rate of mortality from wounds and injuries received in aetion, of Officers of regiments — chiefly in consequenee of their peeuliar exposure in battle — eontinues to be mueh greater than that of the Men; and from disease and aecident much less:

the annual rates from wounds and injuries in aetion for the first nine months having been for the offieers and men respeetively eleven (11,4) and eight (8,5) per 1 000 each, — and for the following six months forty-eight (47,8) and thirty-three (32,7) per 1 000; the rate for officers in the former period being one-third greater than that of the men, and in the latter period nearly one-half (four-ninths) greater;

from disease and aeeident, for the officers and men respectively, the annual rates were, for the former period twenty-two (21,8) and forty-six (45,5) per 1 000 eaeh, — and for the latter period forty-three (42,6) and sixty-one (60,5); the rate for the officers in the former period being one-half less than that of the men, and in the latter period one-third less.

The mortality of Officers from all eauses (both disease and violenee) has, upon the whole, been somewhat less than that of the Men:

having been for the former period, less by three-eighths of the rate experieneed by the men, and for the latter period less by one-thirtieth only.

In the Eastern forees, for the latter of the two periods eompared, the reverse appears to have been the ease, the rate of mortality of Offieers having been not less, but one-half greater than that of the Men, — a consequenee of the very great proportionate mortality from battle, during the rapid series of severe engagements attendant on the siege of Riehmond in the spring and summer of 1862; eonjoined with the fact to which attention has already been direeted, that the liability of offieers to death from battle is neeessarily much greater than that of the men, — a very large proportion of them, during the engagement, being at the head of their eommands, and singled out by the sharp-shooters of the enemy.

Comparison of the Mortality of Eastern and Western forces, distinguishing by periods, causes and rank.

The rate of mortality, for both of the periods, the ranks and the eauses, has invariably been greater with troops recruited at the West (and as a rule, serving at the West) than with those at the East:

the annual rates from all eauses for the former period of nine months, were for the Western troops (offieers and men together) ninety-five (95,0) and for the Eastern troops thirty-two (31,6) per 1 000 of the average force, and for the latter period of six months, one hundred and twenty (120,3) and sixty-six (66,1) per 1 000, respectively, — showing the Western rate of Mortality generally to have been for the former period three times, and for the latter period twiee the Eastern rate.

The Western rates from wounds, for offieers and men together, for the above-mentioned periods, respectively, were nearly five times, and one and one-half times the Eastern rates; and from disease nearly three times and twiee those rates.

The Western rates generally for commissioned officers were for the former of the two periods nearly three times and for the latter one and one-half times the Eastern; for enlisted men the Western rates were for those periods respectively three times and twice the Eastern.

The rates of mortality from Disease in the Western armies during the last eight months of the periods under consideration were diminishing; having fallen from 110 per 1 000 in January, to 86 in the month of August following, indicating an improvement in the Sanitary Condition of the Western Forces.

Comparison of the Mortality from Disease and from Violence, distinguishing by periods, locality, and rank.

The mortality from Violence for the earlier period was much less than from Disease, in both sections of the army, with officers and with men; but for the later period, the mortality of the officers from Wounds in action was, both with the Eastern and Western forces, somewhat greater than from Disease, that of the men continuing less:

in the earlier period the death-rate of the Officers, of both sections together, from disease was nearly double (1,91 times) that from wounds, but in the later period it was one ninth (0,11) *less;* — with the Men, in the earlier period the death-rate from disease was five and one-third (5,35) times that from wounds, and in the later period nearly double (1,85 times). — With Officers and Men together, East and West, in the earlier period, the death-rate from disease was five and one-fifth (5,19) times that from wounds, and in the later period twice (1,80).

Recapitulation. — Mortality by Periods, Rank, Locality and Causes.

To recapitulate. From the above statements and from inspection of Table I (Appendix), it appears that the rates of mortality of the National volunteer soldiers, Eastern and Western, have been increasing both with officers and with men, from wounds and from disease.

Also, that the increase-rate has been greater with the Officers than with the Men, both at the East and at the West, from wounds and from disease, — although the mortality-rates from disease of the men have invariably exceeded those of the officers, while their mortality from violence continues to be invariably less.

Also, that the proportionate increase has been greater with the Eastern than with the Western forces, both with officers and with men, from wounds and from disease, — although the rates of mortality themselves have been less with the Eastern than with the Western, for both ranks and both causes.

Also, that the increase-rate has been greater from Wounds than from Disease, both with officers and with men, at the East and at the West, — although, the mortality of the Men has in general been greater from Disease than from Wounds, for both periods and both sections; so also, during the earlier period, with the mortality of the Officers, but later the reverse has been the case, their mortality from wounds having exceeded that from disease.

Causes of the Greater Mortality of the Western forces.

The excess in the rates of mortality of Western over Eastern troops is believed to be due mainly to over-exertion, as the result of long-continued and forced marches, and of frequent battles; and to inadequate supplies of comforts requisite for the preservation and restoration of health, especially of food in such variety (the quantity generally being ample) as to prevent the occurrence or continuance of diseases of a scorbutic character. This inadequacy of supply has been in some measure a consequence of insufficient transport communication. — An additional reason for the relative excess of mortality can perhaps be found in the less provident habits of the Western soldiers, in their greater disposition to neglect appliances

for personal comfort, and in the greater neglect of, or lack of means for, the observanee of hygienie laws; and in some measure to the malarious charaeter of mueh of the eountry in which the armies encamp, and through which they move; to which, perhaps, may be added that the regions of the West, in general, being more recently settled and less thoroughly eleared, are inferior in point of salubrity to those of the East.

Speeial inquiries and publieations conecrning the condition and wants of the Eastern forees — these forees being the more aeeessible — have, in general, been more exact, prompt and eonstant than of the Western; thus affording opportunity for the more timely arrest and abatement of growing evils.

Mortality of Discharged Invalids.

The mortality of soldiers discharged from the service for disability, surrounded as most of them are by the comforts and kindly attentions of home, probably does not exceed, perhaps not equal, that experienced by their apparently more vigorous companions who remain in aetive serviee. Coneerning this mortality, however, we have as yet little definite information.

Mortality of Other Communities and Periods.

For the purpose of comparison, attention is now ealled to the following illustrative facts respeeting other eommunities and periods.

The annual death-rate both in Europe and America of civilians at the military age*) is 9 or 10 per 1000; or about one eighth of the average rate experienced by the Union armies. The annual death-rate of the United States military forces in time of peace has been 26 per 1000, or about one third of the same rate. The death-rate of the British military forces at home in time of peace (previous to the sanitary improvements consequent upon the introduction of the new statistical system)**) has been about 18 per 1000, and that of their forces both at home and abroad during peace, for the 15 years, 1839—53, 33 per 1000. During the war with Mexico (1846—1848) the average annual rate experieneed by the United States forces was 118 per 1000, of which 14 was from wounds received in action (including killed in battle), and 104 from disease and accident. During active operations in the Spanish Peninsula in the years 1811—14, the annual rate experieneed by the British forces was 165 per 1000, of whieh 52 was from wounds, and 113 from disease; and, in the campaign of the Allies against Russia, in 1854—56, the rate experienced in hospitals alone (not including killed in battle) by the British forces was about 232 per thousand of the average strength — 30 from wounds, and 202 from disease.

It appears then that the mortality of our armies during the present war (72 per 1000 strength per annum, i. e. 20 from wounds, and 52 from disease), has been much greater than that of civilians at home of the same ages, greater than with armies generally in time of peace; but, very considerably less than that of other protracted wars, of whieh we have published records; — the rate of mortality from all causes experienced by our armies in the war against Mexico having been one-half greater, that of the British troops, in the war on the Spanish Peninsula, more than double, and that of the British forces in the Crimea, more than three times that experienced by the Union armies in the existing war. From wounds — including killed in battle — the rate in the Mexican war, with fewer battles and an enemy less intelligent and therefore less effective, was nearly one-third less than in the existing war; with British forces in the Crimea very considerably greater, and with British forces on the Spanish Peninsula two and one-half times our present rate. From disease the rate of mortality with the United States forces in the Mexican war was double, with the British forces on the Peninsula more than double, and with the British forces in the Crimea nearly four-times the average rate experieneed in the existing war for the periods under consideration.

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*) Reports of the Registrar-General of England.
Proceedings of the American Association for the Advancement of Science, at Albany 1856, and at Montreal 1857.

**) Since the introduction of the new system, and apparently attributable in large part thereto, the actual rate of mortality experienced by the British armies both at home and abroad has been very greatly diminished. This excellent model has been recommended by the International Statistical Congress, at a previous session, for general adoption.

Average Strength of Regiments, and relative Proportion of Officers and Men.

The average strength of regiments was, for the former period of nine months, 872 — including officers and men — and, for the latter of six months, 784, about one-tenth less. The average strength of the Eastern regiments was 864 and 812, and of the Western 892 und 758 for the two periods respectively.

In the former period, 40 per 1 000 of the regimental force were commissioned officers, and the remaining 960 enlisted men; in the latter period, the regimental officers comprised 42 per 1 000 of the force. The proportions at each period, for the Eastern and the Western forces, were nearly identical.

Relative Proportions of Present and Absent.

In the former period, sixty-seven (67) per 1 000 (or 1 in 15) of the regimental force were returned as absent from their regiments — on detached service, sick-leave, furlough etc. — the remaining nine hundred and thirty three (933) being present; in the latter period, one-hundred and seventy-two (172) of the 1 000 (or 1 in 6) were absent. Of the Eastern troops, in the former period, fifty-four (54), and in the latter, one-hundred and thirty-eight (138) of the 1 000, and of Western troops ninety-one (91), and two-hundred and six (206), for these periods respectively, were returned as absent.

Constant Sickness.

Like the rates of mortality, the rates of Constant Sickness — including present and absent — have somewhat increased; they have also, as a rule, continued less with the Eastern than with the Western forces; less with officers than with privates.

In the former period, the sick were mainly present with their regiments, in the latter period, mainly absent therefrom; in the former three-fourths (or 74 per cent.) of the sick being present, and in the latter but three-eighths (or 38 per cent.)

Comparison of the Proportion of the regimental force Constantly Sick, at different Periods, distinguishing present and absent.

Present Sick. In the former period, the average constant number present with their regiments, but excused from duty on the ground of sickness (including sickness from wounds as well as from disease) was 83 per 1 000 of the whole number present, or seventy-seven (77) per 1 000 of the whole force present and absent; in the latter period, the proportion of sick present was 78 per 1 000 of the force present, or sixty-four (64) per 1 000 of the entire force, present and absent; showing that the proportion of present-sick to the entire force, present and absent, was, in the latter period, about one-sixth *less* than in the former.

This diminution in the proportion of the sick present with the army, in passing from the earlier period of comparative quiet, to the later one of great activity, with its larger general rates of mortality and sickness, is attributable to the fact, that in periods of active operations, the severer cases of sickness are promptly transferred from the regimental, division, and corps hospitals near the field of action, to the general hospitals distant therefrom.

Absent Sick. In the former period there were constantly absent on sick-leave (regimental officers and men together) 397 per 1 000 of the entire number absent, or twenty-seven (27) per 1 000 of the entire regimental force both absent and present; in the latter period the proportion absent on sick-leave was 607 per 1 000 of the force absent, or one hundred and four (104) per 1 000 of the entire force, present and absent; — showing that the proportion of absent-sick to the entire force, absent and present, in the latter period, about four times that of the former.

Sick, Present and Absent. In the former period, then, the entire constant number of sick, including present and absent, was one hundred and four (104) per 1 000 of the entire regimental force present and absent (or one in ten, showing an annual average of thirty-eight (38,0) days sickness to each man); and in the latter one hundred and sixty-nine (169) per 1 000 of such entire force (or one in six, showing an annual average of sixty-two (61,7) days sickness to each man); — the proportion of the force sick in the latter period being greater than in the former, by five-eighths of the former rate.

Effective Force. Hence the effective proportion of the entire regimental force returned — including both officers and men, present and absent — was, in the former period, 896, and in the latter, 831 per 1 000, or one-fourteenth less. Of those present with their regiments, 917 per 1 000 in the former period, and 936 per 1 000 in the latter were effective; or about one-fiftieth *more* in the latter than in the former period.

The proportion of effective strength above-given is probably somewhat understated, because with the present-sick are included many cases of slight indisposition, not so serious as to incapacitate for active service in case of impending battle or other emergency.

Constant Sickness, Eastern and Western compared.

The rates of Constant Sickness, like those of Mortality, have been for both periods and both ranks, less with the Eastern than with the Western forces.

In the Eastern forces during the former period the proportion of constant sick present to the strength present was sixty-four (64) per 1 000, and the proportion of sick both present and absent, to the entire regimental strength, present and absent, was seventy-six (76) per 1 000; during the latter period these rates were respectively sixty-four (64) and one hundred and twenty-eight (128).

With the Western forces during the former period the rates were one hundred and twenty-three (123) and one hundred and sixty-one (161), respectively; and for the latter period ninety-two (92) and two hundred and eleven (211).

Hence the proportion sick, including present and absent, of the whole force, present and absent, was in the former period one-half (55 per cent.) and in the latter two-thirds (65 per cent.) greater with the Western than with the Eastern forces.

Constant Sickness rates of Officers and Men, compared.

The Constant Sickness rates of the Men, both with the Eastern and the Western forces, continue to be greater than of the Officers.

The aggregate rate (including present and absent) for the former period, of the commissioned Officers was sixty-nine (69) and of the enlisted Men one-hundred and six (106) per 1 000 strength (present and absent); and for the latter period the rate of Officers was one-hundred and eight (108) and of the Men one-hundred and seventy-two (172), — showing the rates for the Men to have been, for the former period five-ninths (or 54 per cent.), and for the latter period six-tenths (or 59 per cent.) greater than those of the Officers.

Constant Sickness. — Recapitulation.

From the preceding statement, and from Table II, it will be seen that the aggregate rates (present and absent together) of constant sickness were greater, in the latter of the two periods compared, than in the former, both with Eastern and with Western forces, with officers and with men;

also, that the rates generally — whether of present or absent — for both periods and both ranks, have been greater with the Western than with the Eastern forces;

also, that for both sections of the army and for both periods, these rates have been greater with the Men than with the Officers.

In the regimental returns under consideration, those under treatment in consequence of wounds are not distinguished from those whose sickness is the result of disease.

The records of sickness in the armies of Great Britain, and of some of the other countries of Europe, include only the sick in hospitals, while for the United States, such records embrace in addition many cases of slight indisposition not in hospital. Hence it is difficult to compare satisfactorily the rates of sickness in the armies of the United States and of such other Countries.

Sickness in the Army of the Potomac.

from October 31, 1862, to March 31, 1863.

In Table III are exhibited the rates of constant sickness in the Army of the Potomac, at different dates from October 31st 1862 to March 31st 1863 inclusive, the last mentioned date being *later* by seven months than any hitherto considered. The results were derived from the Consolidated returns of strength and casualties made three times a month by the Commanding General. Previous to that of November 30th 1862, the consolidated returns specified only the number of present sick, not separating the absent sick from those absent for other cause.

It will be seen that the sickness rates of the Army of the Potomac, during this period — including sickness from wounds as well as from disease — are in general greater than those already commented on. The period embraces the occasions of the important battles under Major-General Burnside, at and near Fredericksburg, Virginia. The soldiers constituting this army were much more actively engaged, during the period, than other troops serving at the East and South-East.

Casualties Generally of Non-commissioned Officers and Privates.

Earlier Period. The excess of loss over gain (Table IV) to the Enlisted Men of all the regiments (both Eastern and Western) making returns — exclusive of gain or loss from recruits, expiration of the term of service, and transfer — was, for the earlier period of nine months, at the annual rate of two hundred and twenty-two (222) per 1 000 strength; of which 54 was loss from deaths, 100 loss from men discharged from service (not including those discharged for expiration of its term, but mainly for disability), 50 the excess from desertion over return of deserters to duty, 14 from missing in action not subsequently accounted for, and 4 the annual excess of loss over gain from other specified and unspecified causes (as promoted, dropped, etc.).

Later Period. Such excess of loss over gain was, for the later period of six months, at the annual rate of three hundred and fifty (350) per 1 000 strength; of which 93 was loss from deaths, 145 loss from men discharged from service (not including those discharged for expiration of its term), 67 the excess from desertion over return of deserters to duty, 40 from missing in action not subsequently accounted for, and 5 the excess of loss over gain from other causes, specified and unspecified.

Transfer. During the former period, the loss from transfer appears to have exceeded the gain by seven, while for the latter, the gain was in excess by three. The small disparity apparent between gain and loss by transfer would probably have been rendered still smaller, had all the volunteer regiments in the service regularly furnished to the Department the required returns; although some allowance is to be made for loss to Volunteer regiments, by transfer from the ranks of their enlisted men to the Regular service and to organisations for special purposes.

During the former period, recruiting of the regiments progressed at about the same rate as, but somewhat more rapidly than, their depletion; during the latter period less rapidly.

Concerning other Returns respecting Sickness and Mortality.

The returns under consideration in the bureau of the Adjutant-General — compiled on the principle of accounting for every man not present for duty — give no information respecting the number of cases of sickness coming under medical treatment during the year or other definite period, and none from which, independently, the average duration of the sickness or treatment may be ascertained. The bureau of the

Surgeon-General, however, contains valuable data on this subject, also interesting details respecting the specific causes of sickness and mortality. In each of these bureaus there are returns respecting the casualties of battle.

Classification of Disease. Within a few months, the old and unphilosophical system hitherto employed for the classification of disease in the Army, has been discarded by the present Surgeon-General (Dr. Hammond), and another system adopted, differing somewhat from, but identical in its leading features with, that recommended by the International Statistical Congress at one of its former sessions. By a very few simple computations, observations classified according to these two methods, may be rendered strictly comparable.

Hospital and Battle Returns. Very exact and complete information respecting the *status* and *movement* of the sick-population of the General Hospitals of the Army of the Potomac, less complete, however, for other armies and military departments, has been carefully abstracted and arranged from records furnished daily, for several months, by Medical Directors in the Army to one of the Departments of the Sanitary Commission — its »Hospital Directory«; information also respecting special Battles has been collected and prepared; — but the results are not accessible at the time and place of writing *).

II. Physiological and other Characteristics.

Sources of Information.

Special examination by the Sanitary Commission. An extensive series of individual inquiries and measurements, of a physiological character, respecting the volunteer soldiers of the United States Army has been instituted and is being conducted by the Sanitary Commission. Nor are these researches confined to the loyal soldiers alone, but like investigations have been instituted with the prisoners of war temporarily confined on one of the islands in the harbor of New-York. Copies of the forms employed for these inquiries, have already been presented to Presiding Officer of the Congress.

The enquiries embrace, among other subjects, the age of the soldier, his nativity, nationality, and race (if other than Caucasian), the place and time of his enlistment, his conjugal relation, his former occupation, his ordinary condition as regards health and vigour, condition at the time of examination, his height, circumference of chest and other measurements of the body, capacity of chest (in cubic inches as tested by the spirometer), muscular power (as tested by the dynamometer), weight, facial angle, condition of teeth, hair as to color and baldness, eyes, as to color, prominence and distance between pupils, pulse (number of beats per minute), respiration (number of inspirations per minute) etc. etc.**)

With these physiological enquiries are incidentally introduced others respecting the former and present habits of life of the Volunteer, and his social characteristics generally.

Physiological examinations of about four thousand individual soldiers have already been made, and the observations are still in progress. From about seventeen hundred of these examinations certain general results are now presented; the discussion of the data, however, not yet being completed.

Apparatus for Measurement. To facilitate the investigation, the various dimensions of the body as to length and breadth, — as entire height, height from ground to the lower part of the neck (7th cervical vertebra), height to perinaeum, breadth of neck, breadth across the shoulders, and breadth of pelvis, — are taken at one measurement, by apparatus specially devised for the purpose, and carefully constructed at the office of the United States Coast-Survey, under the supervision of Prof. Bache, the distin-

*) A valuable paper, respecting wounds and injuries of late engagements, and the surgical operations consequent thereon, by Dr. Brinton, of the office of the Surgeon-General, has just appeared in print.

**) Inquiries of a nature somewhat similar, were to some extent prosecuted, at a very early period of the war, by the eminent Secretary of the Smithsonian Institution — Prof. Henry.

guished chief of that bureau. The graduations are in inches and tenths of inches. The apparatus once being adjusted to the individual under examination, he may leave it, and the inspector subsequently read therefrom and note the measurements. The instrument for measuring the facial angle, was also constructed at the office of the Coast Survey; and was designed by Mr. Joseph Saxton of that bureau.

The spirometers employed are dry-meters, manufactured for the purpose by Messrs. Code, Hopper and Co. of Philadelphia. The dynamometers are from the manufactory of Mr. Thomas of New-York. For ascertaining weight, the counter platform-scale of Messrs. Fairbanks and Co. is used.

Two complete sets of the apparatus above described are now employed in conducting the investigations.

Official Descriptive Lists of Regulars. Descriptions of each soldier entering the Regular military service of the United States — specifying age, height, former occupation, place of birth, place of enlistment, complexion, color of hair and of eyes (a less extensive series than that of the Sanitary Commission as specified above) — have for many years been filed with the Adjutant-General, and abstracts therefrom carefully entered in books prepared for the purpose.

Descriptive Lists of Volunteers. Descriptive lists of members of Volunteer regiments, at the time when such regiments entered the government service, though usually in the possession of the regimental adjutants, are not as a rule deposited with the Adjutant-General. The only ones which have as yet come under observation are from the State of Iowa.

Descriptions of Recruits joining regiments, subsequently to their formation and acceptance by government, are in very many cases on file with the Department; but the number of such papers is small compared with the whole number of volunteer soldiers who have enlisted. The greater part of the recruits prefer forming new regiments to entering those already organized and in the field.

Muster-rolls. Very complete returns of the ages of soldiers at the time of entering the service, are to be found in the muster-rolls of regiments, deposited with the Department.

Investigation of the several official records above-mentioned has been commenced by the Sanitary Commission, and is still in progress.

A portion of the physiological results arrived at from these several sources of information, official and otherwise, is herewith presented. A more complete statement cannot conveniently be given on the present occasion.

Ages.

In Table V are given, derived from investigation of official records, the ages of 51 271 Volunteers (officers and men together) from the State of Massachusetts at the time of acceptance by the General Government of the regiments to which they belong. Recruits, joining the regiments subsequently to the dates of such acceptance, are not included.

Preponderance of Numbers at the Younger Ages. On inspection of the Table, it will be seen that the numbers of the Massachusetts volunteers at the earlier ages are greatly in excess of those at the later, the numbers rapidly diminishing as the age increases.

> More than one-eighth (or 13 per cent.) of the entire number were under the age of nineteen (19) years, more than one-fifth (or 22 per cent.) under the age of twenty (20) years, more than one-half (52 per cent.) under the age of twenty-four (24) years, and three-fourths (or 75 per cent.) under the age of thirty (30) years; — or, considering only the numbers in the interval of twenty-eight years from the age of eighteen to that of forty-five inclusive — the few outside of these limits being omitted, — one-eighth of the force will be found in the first year of the period, leaving only seven-eighths for the remaining twenty-seven years; more than one-fifth in the first two years of the period, leaving less than three-fifths for the remaining twenty-six years; more than one-half in the first six years, leaving less than one-half for the remaining twenty-two years; and three-fourths in the first twelve years, leaving only one-fourth for the remaining sixteen years of the period.

This diminution of numbers with increasing age is much more rapid with the volunteers than with the population from which they spring.

According to the returns of the Census ordered by the State of Massachusetts for the year 1855, two-fifths (or 41 per cent) of the entire number of persons living between the ages of twenty (20) and forty (40) years were over the age of thirty (30); while with the volunteers for military service from that State, the corresponding proportion was one-thirtieth only (or 3¼ per cent) — the latter proportion being but one-twelfth of the former.

The above and other data of like character justify the conclusion, that a self-selected army —, that is, one of volunteers — must be recruited chiefly from the young; because, perhaps, more adventurous, conscious of greater surplus energy, and less trammelled by responsibilities of a domestic or business character.

According to official returns of the British recruiting service, for the year 1860 (a time of peace) the preponderance of the young was much greater than that indicated above — nearly one-third (30' per cent.) having been under the age of nineteen years, more than one-half (56 per cent.) under the age of twenty-one years, and more than three-fourths (77 per cent.) under the age of twenty-four years*).

Average and Probable Ages. The average age of the fifty-one thousand (51 271) Massachusetts volunteers was twenty-six (25.99) years; and their equate**) age — or the age above and below which their numbers were equal, — was twenty-three and three-fourths (23.74) years. — The average age of nearly eight hundred volunteers of the Army of the Potomac examined under the direction of the Sanitary Commission, at the »Convalescent Camp« near Alexandria, Virginia, was twenty-five years; that of a somewhat larger number of the same army, examined at Aquia Creek Landing, Virginia, was twenty-three years.

British. The average age of recruits to the British army from the United Kingdom, during the year 1860, as calculated from data published in the Official Report for that year, was about twenty-one and one-half (21.4) years, and their equate age twenty and one-half (20.5). The average age of the recruits, for the year 1861, was twenty-one (21.0) years; and their equate age twenty (20.1) years. — In calculating the average age of these recruits, an estimated distribution was made of the numbers at and over the age of 25 years, and under that of 17.

The average age of soldiers not recruits, serving in the British army at home on the first of

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*) The following Table compares the distribution with respect to age on entering military service, of the United States volunteers above mentioned, and the recruits to the English Army (also volunteers) for the year 1860. The proportionate excess of the latter at the earlier ages will be noted.

Ages.	Proportion at the Different Ages. Massachusetts.	English.	Differences.
Under 17 years.	35	101	+ 66
From 17 to 18	56	433	+ 377
18 » 19	1 248	2 501	+ 1 253
19 » 20	844	1 283	+ 439
20 » 21	680	1 272	+ 592
21 » 22	979	848	— 131
22 » 23	714	756	+ 42
23 » 24	597	534	— 63
24 » 25	530	580	+ 50
At 25 and over	4 317	1 692	— 2 625
All Ages	10 000	10 000	

»The boys under 17 were enlisted as drummers and musicians, and those from 17 to 18 were for the most part growing lads. It is believed, however, that many young men of this age are included with those from 18 to 19, because service under 18 years of age is not allowed to count for pension, and there is consequently a strong inducement for lads to overstate their age, while no means exist by which their statement may be verified.« (Army Statistical Report, 1860.)

**) The word probable is sometimes used in the same sense, but is liable to mislead the reader.

April 1860, was about twenty-four and three-eighths (24.36) years, and their equate or probable age twenty-three (23.2) years.

The average age of European troops (non-commissioned officers and men) in the service of the late East India Company as deduced from data given in the Report of Commissioners appointed by the British Government to inquire into the sanitary state of the army in India, was for the 10 years 1847 to 1856, thirty and one-half (30.6) years, and their equate age twenty-nine (28.9).

Prussian. The average age of the officers and men (222 029) of the Prussian army on the third of December 1861, as estimated from official data in the Royal Statistical Bureau, was about twenty-three and one-half years*), and the age above and below which their numbers were equal twenty-one and one-sixth years.

Limiting Ages. The limiting ages prescribed for enlistment into the military service of the United States are those of eighteen and forty-five years**). A few are enrolled at ages without those limits.

It will be observed that the numbers returned for the ages of eighteen (18) and forty-four (44) years are large, compared with other numbers near those ages. The numbers so returned probably include men, not within the limiting ages of eighteen and forty-five, who purposely misstate in order that their services may be accepted.

Also in the year of age twenty-one (21) — on attaining which, young men become legally independent of the protection and control of parents and guardians — the number returned is notably in excess of the numbers at other ages in the vicinity. It is believed that many of the youths so returned properly belonged with those of nineteen and twenty, but overstated in regard to age, to secure the acceptance of their services.

Law of the Distribution of Age. Allowance being made for the manifest irregularities above-specified at the limiting ages, and for others of less moment and due mainly to the smallness of the number of observations in each of the several years of age, it will be found, that the numbers progress very nearly in accordance with a simple law, namely, that of *the sum of a series of terms in equi-rational (or geometrical) progression.*

> For instance, — if the proportionate numbers in the interval of twenty-four years from the age of nineteen to that of forty-three (Table V, Column 6), be divided into four consecutive groups of six years each, the first differences of the resulting series will be found to be respectively, 2 203, 1 010, and 413; of which differences the second is a little less than one-half (46 per cent.) of the first, and the third in turn nearly the same proportion (41 per cent.) of the second.

On the assumption of the above-mentioned approximate law of relation, values, for each year of age from eighteen to forty-five inclusive, have been calculated. (See Columns 5 and 7, of Table V.) In the calculated series, the sums of the numbers, at and over the equi-distant ages of 19, 27, 35 and 43 years (Column 5), were assumed to be the same as in the observed series (Column 4). — To the Table are appended the Formulas employed in its construction.

If the relation of the ages and the numbers in the calculated series be represented by rectangular coordinates, whereof the abscissas shall denote the ages, and the ordinates the corresponding numbers, the extremities of the ordinates may be connected by the well-known *logarithmic* curve. (See Diagram B.)

The observed and the calculated numbers at the different ages (Columns 6 and 7) differ but little from each other, — the largest differences being in the vicinity of the limiting ages (18, 21 and 45),

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*) In estimating the average age, the proportionate distribution of the numbers of the military over the age of 60 years, was asumed to be identical with that of the civil population. Certain allowance was also made for the probable diminution with advancing age, after that of 19 years, of the numbers within the several age-intervals in which the given data were grouped.

**) Under the law for Conscription, lately enacted, the inferior limit is twenty years, although substitutes may be accepted under that age.

In ancient Rome the obligation to military service ordinarily extended from the age of seventeen years to that of forty-five, but in emergencies from seventeen to sixty years.

where, as has been already remarked, there is reason to believe that the observations themselves are of questionable accuracy. Indeed, it is not improbable, that, at and near these ages, the calculated values represent more truly the actual distribution than the recorded observations on which they are based.

If from the calculated number in each year of age, from that of eighteen years to forty-five inclusive (Column 7, Table V), the number eighty (more exactly 80.4) be taken, the remainder will be found in each case to be seven-eighths (more exactly 0.8626) of the one immediately preceding; and if these remainders be taken together in quinquennial periods, each group will be nearly one-half (0.47) of the group just preceding.

The following brief Table compares, in groups mainly quinquennial, the observed with the calculated values at different ages. It will be remarked that the differences between these values are small, averaging, without regard to their positive and negative signs, about four (4.4) per cent. of the number of observations in their respective intervals of age.

Comparison of the Observed and Calculated Distribution with respect to Age of Volunteers from the State of Massachusetts, on entering the service. Number of Observations, 51 271.

Ages. Years.	Proportion per cent. at the different Intervals of Age. Observed.	Calculated.	Differences between the Observed and Calculated Values.
Under 18	0.9	2.1	— 1.2
18 to 20	20.9	21.2	— 0.3
20 » 25	35.0	33.7	+ 1.3
25 » 30	18.6	18.2	+ 0.4
30 » 35	10.6	10.8	— 0.2
35 » 40	7.4	7.3	+ 0.1
40 » 45	5.9	5.5	+ 0.4
45 and over	0.7	1.2	— 0.5
All Ages	100.0	100.0	— 2.2
			+ 2.2

The assumption of simply an equi-rational law to represent the proportionate numbers enlisting in the army at the different ages, would give a series approximating to the observed, though not so closely, in this case, as that adopted — namely, the sum of an equi-rational series. Allusion has already been made in one of the publications above-mentioned*) — but based upon more limited data — to the correspondence observable between the distribution of the ages of volunteers, and a series diminishing by a common ratio.

The consideration of the important subject, of the relation of age to the mortality, the sickness, and the invaliding of troops, can not now be entered upon.

The Human Type, and the Law of the Distribution of Variations therefrom.

Statistical researches, conducted by M. Quetelet of Belgium, have established the fact, previously contested, of the existence of a human type, and that the casual variations from it are subject to the same symmetrical law in their distribution as that, which the doctrine of probabilities assigns to the distribution of errors of observation. In the accompanying tables, showing the distribution of heights and of measurements of the circumference of chests of American soldiers, the conclusions of this eminent statist and mathematician are strikingly confirmed.

*) Sanitary Commission Document No. 40, p. 14.

This law — based on the assumption of the operation of an indefinite number of independent causes of finite variation or error, equally favoring excess and defect — may be expressed by a very simple analytical function (see Note in Appendix), first investigated by J. Bernouilli in its relation to the probable distribution of errors of observation of a single object; extended by Poisson, under the title of »the law of large numbers«, to the measurement of many objects, representatives each of a common type; and first applied by M. Quetelet to the physical measurement of man.

The average measurement and the mean variation having been ascertained, we have — when the numbers are large, and the influence of arbitrary interference with the law inconsiderable — all the elements necessary to a statement of the probable distribution*).

Conversely, when the interference with the law of distribution in certain known parts of a series of observed values is large (as when, in measurements of the heights of soldiers, the minimum of height requisite for service, established by the State and practically recognized by its officers, is high, relatively to the average height,) we may, by an inverse process, ascertain from the given data the numerical values of the elements necessary to such statement, within the limits where the law prevails.

Comparison of the Age-law with the Type-law. According to the law, already stated, which appears to obtain with the distribution of the ages of the volunteers, the differences of the numbers at consecutive equi-distant ages are very nearly in equi-rational or geometrical progression. — In the distribution of the representatives of a type, where the law assigned by the theory of probability strictly holds, the quotients (not the differences) of the proportionate numbers at consecutive equi-distant points of measurement are in equi-rational progression.

Heights.

Recruits to Volunteer Regiments of the United States. — Average Height and Mean Variations. — In Table VI, — derived from investigation of official returns — are given the heights of nearly twenty-six thousand (25 878) recruits to the volunteer regiments of the United States, for the existing war, subsequent to the acceptance of such regiments by the General Government. A portion of the returns — those from Iowa — included also members of regiments at the time of organization and acceptance. About two-fifths of the number were from the North Eastern (or New England) States, and the remaining three-fifths from the Western States of Iowa, Indiana, Michigan, and Minnesota, comprising all on file from those States at the time of examination, in the Summer of 1863.

Average Height. The average height of these recruits, according to the data, was sixty-eight and one-fifth (68,20) English inches, (or 5 feet $8\frac{1}{5}$ inches), equivalent to 17,32 decimetres**).

Mean Variations. The mean variation from the average height was two and one-tenth (2,07) inches (or 52 millimetres); which is three per cent $\left(\text{or } \frac{1}{33}\right)$ of the average height. — The mean variation below the average height was nearly identical with, although slightly less than, the variation above such average; respectively 2,03 and 2,10 inches.

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*) If, instead of the mean variation, where the law of probability strictly obtains, either the modulus of convergence (so called), the equate or probable variation (that is, the variation within and beyond which the distributed numbers are equal), or the variation by mean squares (to wit, the square-root of the sum of the products of the square of each variation into its probability) is known, the above statement still holds. — The modulus is inversely proportioned to the several variations, and if assumed equal to unity, these variations (the mean, the equate, and that by mean squares) will be respectively equal to the numbers 0.56419 $\left(\text{or } \frac{1}{\sqrt{\pi}}\right)$, 0.47644, and 0.70711 $\left(\text{or } \frac{1}{\sqrt{2}}\right)$.

**) 1 English inch = 25,3995 ... millimetres,

$= \left(\frac{100}{4} + \frac{4}{10}\right)$ millimetres (nearly).

1 metre = 39,37079 English inches,

$= 39\frac{3}{8}$, or $40 \times \left(1 - \frac{1}{64}\right)$ inches (nearly).

It will be seen, on inspection of the Table, that the average height marks very nearly the point where the number of observations is greatest.

Height of Volunteers Soldiers in the Army of the Potomac. — Average Height. Carefully conducted measurements by the Sanitary Commission of nearly 1 700 soldiers, not recruits, of the Army of the Potomac, of whom 761 were at the »Convalescent Camp«, near Alexandria, and the remainder at Aquia Creek Landing, show for each of the two groups an average height (in stockings) of sixty-seven inches, or 17,0 decimetres (67,1 inches for the former, and 67,0 for the latter group). — These averages are about one inch (1,1 inches for the former, and 1,2 for the latter) less than that of the recruits above-mentioned.

This observed excess in the height of the recruits over that of the soldiers, is perhaps attributable, in part, to the practice of a less rigorous method of examination by the officers in charge of the former measurements, than that adopted, by the agents of the Commission, with regard to the latter.

Mean Variations. The mean variation from the average height, in the measurements of the 761 soldiers at the former of the two localities, was nearly identical with that of the official measurements of the 25 878 recruits, — that is, two and one-tenth inches (2,11 for the soldiers and 2,07 for the recruits). This variation, in the case of the soldiers, was $\frac{1}{32}$ of the average height. The mean variation below the average height, with the soldiers, was nearly the same as, but slightly less than, that of the mean variation above such height — respectively 2,09 and 2,13 inches.

Height of Recruits to the Regular Service. The average height of recruits to the Regular Army of the United States, according to published official data*) derived from the records of the recruiting service for a series of years previous to the existing war, was about 68,8 inches, or 17,5 decimetres.

Height of Recruits and Soldiers to the British Army. — Recruits. — The average height of 27 853 recruits to the British Army at home for the year 1860, as calculated from data published in the statistical report of the medical department of the army for that year, was sixty-six and one-fifth (66,2) inches, or 16,8 decimetres; the minimum height at which recruits were permitted to be taken by the commission charged with the recruiting having been, for that year, 64 inches, or 16,26 decimetres**).

In the year 1861, the average height of 12 191 recruits to the British army, deduced from data in the report for that year, was sixty-six and four-fifths (66,8) inches; about one half-inch greater than the average of the previous year. The minimum required for service was, for somewhat more than two months of the year (until March 7th), 64 inches; then, for a period somewhat exceeding one month (to April 16th), 68 inches; and for the remainder of the year 66 inches.

Thus, it appears, that the average heights of the recruits to the British army for the years 1860 and 1861, were less than the averages above-given of the American volunteer recruits and soldiers; their ages, also, as elsewhere stated, having been less.

Soldiers. The average height of soldiers in the English Army, according to deductions from a Table published by Mr. Marshall in the Military Miscellany (London), for the year 1846, was sixty-eight and one-half (68,53) inches, a height but slightly inferior to that above-given as derived from the records of the recruiting service of the Regular army of the United States, for a series of years. The minimum of height required for admission into the British service, at this time, appears to have been sixty-six inches.

Height of French Conscripts and Soldiers. Conscripts. The average height of French conscripts, according to data published by M. Boudin***) was, for the classes of the 30 years 1831—62, sixty-five and one-sixth (65.17) English inches (or 16.55 decimetres); the minimum of height required for service

*) Medical Statistics of the United States Army, by R. H. Coolidge, M. D., Asst. Surgeon, U. S. A. (now Medical Inspector).

**) »This standard, of course, was not applicable to boys, nor was it always enforced in regard to eligible growing lads of 17, or of men enlisted for musicians; but in all these cases it was necessary to obtain a special authority from the Adjutant-General.« (Statistical Report 1860.)

***) »Journal de la Société de Statistique de Paris«. — July and September 1863.

»Recueil de Mémoires de Médecine, de Chirurgie et de Pharmacie Militaires«. — Paris. March and July 1863.

during this period having been 61,4 English inches (or 15,6 decimetres). This minimum is still the standard for conscripts to the French army.

The average height of the French conscripts of the years 1818—28 was sixty-five and one-fourth (65,24) inches (or 16,57 decimetres); the established minimum throughout the period having been 61,8 English inches (or 15,7 decimetres).

Soldiers. The average height of the French Army, with the last mentioned minimum, is stated by the same writer to have been sixty-five and three-fourths (65,77) English inches (or 16,70 decimetres), being about six-tenths of an inch greater than that of the conscripts.

Upon examination of 705 men in a regiment of mounted chasseurs of the guard *(chasseurs à cheval de la garde)*, M. Allaire, surgeon to the regiment, found their average height to be sixty-six and one-ninth (66,11) English inches (or 16,79 decimetres), the minimum for that arm of the service being established at 65⅓ English inches (or 16,6 decimetres). The mean age of these men was thirty (30) years; their mean circumference of chest, thirty-five and four-tenths (35,4) inches (or 9,0 decimetres); and their mean weight, one hundred and forty-two (142,2) pounds avoirdupois (or 64,5 kilogrammes).

In order to compare, satisfactorily, the height of French conscripts, with that of recruits to the British and of volunteers to the American armies, it is necessary to make allowance, not only for the difference in the standards adopted for *minima* — the French standard being in general lower than the British, — but also for the relative difference of age; the age of the French conscripts being twenty years, that of the British recruits somewhat over twenty-one years, and that of the United States volunteers from twenty-three to twenty-six years.

The observations concur in showing that at the time of enrolment the conscripts for the French army were younger and of less height than the recruits to the British; and the latter, in turn, of less age and height than the volunteers to the existing army of the United States.

The Law of the Growth of Man is not very definitely ascertained. According to a table published by Dr. Liharzik of Vienna, the average annual increase in the height of males, from the age of 19 to that of 25 years, is four-tenths (0,41) of an English inch (10,4 millimetres). According to observations by M. Quetelet, man does not attain his maximum height until about the age of thirty years, — the average annual increase in the height of the male population of Belgium, from the age of 18 years to that of 25, being one-fourth (0,25) of an English inch (6,3 millimetres).

Distribution of the Measurements of United States Volunteers. It will be observed that the numbers, in the Official observations, herewith presented, as to height, and in those of the Sanitary Commission both as to height and circumference of chest, group themselves in close proximity to the average of the measurements, diminishing, in general symmetrically, and beyond narrow limits rapidly, as they recede from it. From these several observations, have been calculated corresponding values, showing the distribution demanded by theory.

Distribution of Recruits as to Height, Calculated and Observed. — Official Observations.

The following brief Table, condensed from Table VI, compares, grouped in intervals of three inches, the observed with the calculated distributions of the heights of recruits to the volunteer service, as derived from investigation of official records. The differences between these values, it will be seen, are small; averaging, without regard to their positive and negative signs, about four (4,4) per cent. of the observations in their respective intervals of height.

In enlisting for the volunteer forces of the American Army, but little regard, practically, appears to have been had to any standard of height below which men were not to be received. Under the height of 62½ inches, however, the deviation (deficiency) of the observed from the calculated values, — although the numbers themselves, in that vicinity, are small, and the influence of the deviation, on the average height, inconsiderable, — is large compared with the proportionate deviation at any of the other specified intervals of height.

Comparison of the Observed with the Calculated Distribution of the Heights of Recruits to the United States Volunteer Service, — according to Official Observations.

Number of Observations 25 878,
Average Height ..... 68,20 inches,
Mean Variation therefrom ..... 2,07 »

Measures of Height. Inches.	Proportion at each Height to 100 Recruits Measured. Observed.	Calculated.	Differences between the Proportions Observed and Calculated.
Under $62\frac{1}{2}$	0,4	1,3	— 0,9
From $62\frac{1}{2}$ to $65\frac{1}{2}$	14,3	13,5	+ 0,8
» $65\frac{1}{2}$ » $68\frac{1}{2}$	40,8	39,7	+ 1,1
» $68\frac{1}{2}$ » $71\frac{1}{2}$	34,1	35,3	— 1,2
» $71\frac{1}{2}$ » $74\frac{1}{2}$	9,6	9,4	+ 0,2
Over $74\frac{1}{2}$	0,8	0,7	+ 0,1
All Heights	100,0	100,0	— 2,1
			+ 2,1

Distribution of Soldiers of the Army of the Potomac, as to Height. — Observations by the Sanitary Commission.

From the observations on the height of soldiers in the Convalescent Camp (Table VII) have been calculated, by different processes, two distinct series of corresponding values; the one (that in column 5) conforming strictly to the theoretical law now under consideration, while the other (that in column 6) may be regarded simply as an adjustment of the irregularities in the series of observed values, and not as illustrating any theoretical law. The latter of these calculated series conforms, in general, somewhat more closely to the observed values than the former, although the disparity is not great. [For processes of calculation see Note in Appendix.]

Irregularities. The irregularities which may be remarked in the observations on the height of these soldiers, at 64, 65 and 70 inches, are not repeated in the more extended series of Official observations (Table VI), and are not such as may be expected to recur at the same points in the Army generally.

The irregularity in the interval of two inches from $63\frac{1}{2}$ to $65\frac{1}{2}$ — deficient near the greater and correspondingly excessive at the lesser height — may not be entirely accidental, but be owing mainly to a disposition on the part of a portion of the peculiar class of soldiers here examined, whose actual heights were in the inch-interval of which 65 is the middle, to appear and be registered as below such height, for some fancied advantage in facilitating their hoped-for discharge as invalids from further military obligation. — In this interval, then, as in the instance previously stated, it is probable, that the calculated values represent more faithfully the actual distribution, than the observations themselves, which furnished the elements for the calculation.

Inspection of the Diagram will render more manifest the similarities and contrasts between the observed and the calculated values.

In the following Table, condensed from Table VII, are compared, grouped in intervals of three inches, the observed with the probable distributions of these soldiers in the Army of the Potomac. It will be seen that the differences, without regard to sign, average five (5,0) per cent. of the numbers in their respective intervals; a deviation, although small, somewhat larger than in the case of the official observations.

Comparison of the Observed with the Theoretical Distribution of the Heights of certain Soldiers in the Army of the Potomac, — according to Observations by the Sanitary Commission.

Number of Observations..... 761,
Average Height ..... 67,13 inches,
Mean Variation therefrom ..... 2,11 »

Measures of Height. Inches.	Proportion at each Height to 100 Soldiers Measured. Observed.	Calculated.	Differences between the Proportions Observed and Calculated.
Under $62\frac{1}{2}$	2,3	4,0	−1,7
From $62\frac{1}{2}$ to $65\frac{1}{2}$	25,1	22,9	+2,2
» $65\frac{1}{2}$ » $68\frac{1}{2}$	42,3	42,9	−0,6
» $68\frac{1}{2}$ » $71\frac{1}{2}$	25,6	25,3	+0,3
» $71\frac{1}{2}$ » $74\frac{1}{2}$	4,6	4,6	0,0
Over $74\frac{1}{2}$	0,1	0,3	−0,2
All Heights	100,0	100,0	−2,5
			+2,5

By reference to the more extended Tables VI and VII, it will be seen, that the deviation, without regard to sign, of the observed from the calculated values, in the case of the Official measurements, averages but one-half of that of the more limited series of observations by the Commission; being respectively five and one-half (5,6) per cent. and eleven (11,2) per cent. of such values.

This closer conformity of observation to theory, in the case of the Official measurements, was to be expected, their number being much the greater, and the mean variation from the average height, in each of the two sets of observations, nearly identical.

Circumference of Chests of Soldiers.

Volunteers in the Army of the Potomac. — Average Circumference and Mean Variations. From examination of records of measurements of the circumference of the chests of over fifteen hundred (1 516) soldiers not recruits in the Army of the Potomac, conducted by the Sanitary Commission, it appears that the average circumference was thirty-five (34,99) English inches, or 8,9 decimetres; that the mean variation from this average was one inch and two-thirds (1,66), or 42 millimetres — this mean variation being equal to $\frac{1}{21}$ (or four and three-fourths (4,74) per cent.) of the average circumference; and that the average variations in defect and in excess were nearly identical, being respectively 1,67 and 1,65 inches. These measurements were taken over the nipples, under the coat and waistcoat, but over the woolen shirt worn by the soldier.

Of these 1 516 measurements, 776 were made at the Camp for Convalescents, and the remaining 740, at Aquia Creek Landing — the latter being in average health. The whole number of chest-measurements at the latter locality was 916, of which number 176 were returned as not in usual vigor, and are not included in the data under consideration. Their retention, however, would have produced no sensible change in the average.

The averages of the measurements at the two places are nearly the same, $35\frac{1}{8}$ inches for those at the Camp, and $34\frac{7}{8}$ for those at Aquia — two years younger; the greater circumference being with those of the greater age.

Circumferences of the Chests of certain Soldiers in other Countries. — French Soldiers. The mean circumference of the chests of 705 members of the French regiment of mounted chasseurs of the guard, already alluded to, was thirty-five and four-tenths (35,4) English inches (or 9,0 decimetres)

— their mean age having been 30 years, and mean height 66,11 inches. — Their mean circumference of chest, consequently, exceeded by four-tenths of an inch (assuming the measurements to have been conducted in a manner essentially similar) that just presented of soldiers in the Army of the Potomac, whose mean age was six years less, and mean stature one inch greater.

Scottish Soldiers. According to a Table published by M. Quetelet, showing the distribution of the measurements of the chests of certain Scottish soldiers, the average circumference was forty (39,8) English inches (or 10,1 decimetres). The Table was accompanied with no information indicating whether the men selected were to be considered as fair representatives of the average of Scottish soldiers, or (which is altogether probable) as superior in age and general dimensions.

Comparison of Observed and Calculated Distributions of Measurements of the Chests of Volunteers. The general expression, for the law of the probable distribution of measurements of the circumference of the chest (as elsewhere intimated), is the same as that which governs the distribution of heights, differing only in the numerical values of the constants. In Table VIII are compared the observed with the probable distributions of the fifteen hundred (1516) measurements of soldiers of the Army of the Potomac. The differences between the observed and the calculated proportions corresponding to the several unit-intervals of measurement, are, in general, not large; averaging — without regard to the positive and negative signs — about four (4,2) per cent. of the respective numbers in such intervals.

The greatest deviations are in the immediate vicinity of the average measurement (that is of 35 inches); the number recorded at this point considerably exceeding the calculated or probable number, and being compensated by corresponding deficiencies immediately within and beyond. This marked disparity does not occur in the case of the earlier observations made in the winter of 1862 — 1863 at the Convalescent Camp, but is wholly confined to those made at Aquia Creek Landing during the spring of 1863. A bias, if it existed, in the mind of the observer, in favor of thirty-five inches as the probable average, would account, in part at least, for the disparity. Such bias was not possible with respect to the earlier observations, no average having been calculated until about the date of their completion.

The following Table, condensed from Table VIII, compares, grouped in consecutive intervals of three inches, the observed with the calculated numbers. It will be seen, that the conformity of observation to theory is very close; the differences in the several three-inch intervals averaging — without regard to sign — less than one (0,8) per cent. of the values in such intervals.

Comparison of the Observed with the Calculated Distribution of the Circumferences of the Chests of Soldiers in the Army of the Potomac, — according to Observations by the Sanitary Commission.

Number of Observations..... 1516,
Average Circumference ..... 34,99 inches,
Mean Variation therefrom ..... 1,66 »

Measures of Circumference. Inches.	Proportion at each Measurement to 100 Soldiers examined. Observed.	Calculated.	Differences between the Proportions Observed and Calculated.
Under 30½	1,5	1,5	0,0
From 30½ to 33½	22,2	22,2	0,0
» 33½ » 36½	53,0	52,9	+0,1
» 36½ » 39½	21,5	21,9	−0,4
Over 39½	1,8	1,5	+0,3
All Measures	100,0	100,0	−0,4
			+0,4

Comparison of the Convergence (absolute and relative), as to Distribution, of the Measurements of the Circumference of the Chest, with that of Measurements of Height. Comparison of the averages above-given respecting measurements of the chest of volunteers, with those of height, shows, that the absolute

mean-variation is about one-sixth less with the former than with the latter — being respectively 1⅔ and 2 inches; — but, that relative to the averages of the respective measurements, the mean-variation in the former case is more than one-half greater than in the latter — being respectively 4¾ per cent. and 3 per cent. of such averages. That is, referable to a fixed unit of comparison (as the inch or the decimetre), the variation is smaller, and the convergence of the observations to the average measurement more rapid, with the measurements of the chest than with those of height; but referred to the quantity measured as the unit of comparison, the reverse is true, the variation with the former measurements being much the larger and the convergence less.

Weight of Soldiers.

Volunteers of the Army of the Potomac. The average weight of the seventeen hundred soldiers of the Army of the Potomac was about one hundred and forty-seven and one-half (147½) pounds avoirdupois (or 66,9 kilogrammes)*); the weight of that portion examined at the Convalescent Camp averaging 148 pounds, and of those at Aquia Creek (two years younger) 147 pounds. The difference (one pound) is inconsiderable.

French Soldiers. The average weight of the 705 French mounted chasseurs — 142,2 pounds avoirdupois, or 64,5 kilogrammes — was about five and one third pounds less than that above-given of the American volunteers.

British Recruits. The average weight of the twenty-eight thousand (27 853) recruits to the British Army for the year 1860, deduced from data published in the official statistical report for that year, was one hundred and twenty-eight (128) pounds; and that of the twelve thousand (12 191) recruits for the year 1861, one hundred and thirty-one (131) pounds — three pounds greater. The mean weight of these recruits was therefore less by about eighteen pounds than that of the American volunteers; their age and height also being less, as elsewhere specified, the age by nearly three years, and the height by about two-thirds of an inch.

In the following Table are compared the average ages, heights, weights and circumferences of chests of American volunteers, with corresponding averages for certain European soldiers.

	Number of Observations.	Averages.			
		Ages. (years)	Height. (inches)	Weight. (lbs.)	Circumferences of Chest. (inches)
United States Volunteers — existing War:					
from Massachusetts — on enlistment, 1861—63	51 271	26	—	—	—
Recruits generally, 1861—63	25 878	—	68,2	—	—
Soldiers in the Army of the Potomac, 1862—63	1 700	24	67,1	147½	35,0
Recruits to the British Army at home, 1860	27 853	21,4	66,2	128	—
» » » » » » » 1861	12 191	21,0	66,8	131	—
Conscripts to the French Army, 1818—28.....		20	65,2	—	—
» » » » » 1831—60.....		20	65,2	—	—
French mounted Chasseurs of the Guard	705	30	66,1	142,2	35,4
Certain Scottish Soldiers	5 738	—	—	—	39,8

The average annual number of conscripts examined for the French Army (including the rejected), as derived from data published by M. Boudin, has been for the thirty years 1831—60 about 189 000; the

*) 1 kilogramme = 2,2056 pounds avoirdupois; 100 pounds avoirdupois = 45,34 kilogrammes.

average for the sixteen years 1831—46 having been 175 000, that for the subsequent six years, 1847—52, 163 000, and for the eight years, 1853—60, 235 000.

Other Physiological Characteristics of Soldiers in the Army of the Potomac.

In Table IX, are presented, under twenty-two distinct heads of inquiry, at each of two different localities averages of results of observations respecting certain physiological characteristics of volunteers of the Army of the Potomac.

The number of observations under each head, varying somewhat with the different subjects of inquiry, was about seventeen hundred, — four-ninths of which were made at the Camp for Convalescents, and the remaining five-ninths at Aquia Creek Landing. Of the men examined at the former locality, much the larger proportion were in impaired health — either convalescents sojourning here for a few days *in transitu* from the general hospitals of the army to their regiments, or men awaiting medical examination with the expectation of being discharged, as invalided, from further service. At the latter locality about one-fifth represented themselves as not in usual vigor, their health having been impaired by disease, wounds, or hardship, a portion of them convalescents returning to their regiments. The remaining four-fifths are believed to have been in the average state of health of effectives in active service.

The measurements of the circumferences of the chests of soldiers in impaired health at Aquia Creek — hitherto excluded from consideration — are here included, without, however, effecting any sensible change in the average.

Under some of the heads of inquiry — as those of the head, facial angle, and foot — the observations were not so large in number as under the others, having been commenced later.

It will be seen, on inspection of the Table, that the physiological characteristics of the soldiers in the two localities do not greatly differ, especially those which pertain to size and weight; the men examined at the former locality were, however, in general somewhat larger and heavier (as well as older) than those at the latter.

The most marked disparities in the characteristics — and in favor of the more healthy class — are with respect to muscular strength as tested by the dynamometer, to capacity of the chest as tested by the spirometer, and to respiration.

Height and Length. The height from the ground to the lower part of the neck (seventh cervical vertebra) was about fifty-seven inches (57,3 with the former, 57,0 with the latter) — being less than the entire stature by ten inches (9,8 and 10,0 respectively).

The height from the ground to the perinæum was about thirty-one inches (30,6 with the former, 31,1 with the latter) — showing the average length of the body (from perinæum to seventh cervical) with the former class to have been nearly twenty-seven (26,7) inches, and with the latter twenty-six (25,9).

The length of the arm — from the arm-pit to the tip of the middle finger — averaged twenty-eight and one-fifth (28,2) inches, the same with each class; a length nearly equivalent to the established military pace, and to the archine of Russia, each twenty-eight inches*).

The average length of the foot was ten inches, and its circumference over the instep about thirteen.

Breadth. The breadth at the shoulders was equal to about one-fourth of the entire height, and that of the pelvis one-fifth; the breadth at the shoulders being about sixteen and one-half inches

*) The length of the arm, from arm-pit to wrist, does not differ greatly from that of the half-metre; the latter, in some respects, a more commodious unit for the measurement of length than the metre itself.

(16,5 with the former, 16,3 with the latter class), and that of the pelvis somewhat over thirteen inches (13,4 and 13,1 respectively) — or, about three inches less than at the shoulders. — The breadth of the neck averaged with each class four inches (4,1 and 4,0 respectively).

Circumference of the Body. The average circumference of the waist was from two and one-hal (2,4) to three (2,9) inches less than that of the chest, already given; having been, with the class at the former of the two localities, thirty-two and two-thirds (32,7) inches, and at the latter thirty-two (32,0) inches.

These measurements of the circumference of the body differ but little from one-half of the entire height; that of the chest being somewhat greater, and that of the waist less than such half-height.

Head. In two of the four measurements of the head, specified in the Table, the excess was in favor of those at the former locality; in the remaining two, of those at the latter. The disparity between the two sets of observations was not large. — The average circumference about the frontal eminence and the greatest projection of the occiput with each class somewhat exceeded twenty-two inches (22,1 with the former, 22,3 with the latter); the distance between the condyloid processes of the lower jaw over the *os frontis*, longest measurement, somewhat exceeded eleven inches (11,5 and 11,2 respectively); the distance between the condyloid processes over the parietal bones was about thirteen inches (12,8 and 13,1 respectively); and the distance from the frontal eminence to the protuberance of the occiput somewhat exceeded fourteen inches (14,3 and 14,2 respectively).

The average distance between the pupils of eyes was, with each class, two and six-tenths (2,6) inches.

Facial Angle. The facial angle — or the angle included between two lines proceeding from the alveolar process of the upper jaw as the vertex, one to the most prominent part of the forehead, and the other to the external opening of the ear *(meatus auditorius externus)* — was, with the former group of observations, seventy-four degrees, and with the latter, seventy-eight. The number of observations under this head at the former locality was much smaller than with respect to other subjects of inquiry, and the observed disparity of four degrees is perhaps attributable to the limited number of the earlier observations.

Muscular Lifting-Strength. The muscular strength of the less healthy class, that at the camp for convalescents, was much inferior to that of the more healthy at Aquia, the trials of the healthier indicating, on the spring-dynamometer employed, an average lifting power, with both hands, of about three hundred (298) pounds avoirdupois (or 135,1 kilogrammes), and the trials of the less healthy class but two hundred and sixty (260) pounds (or 117,9 kilogrammes); a force less by one-eighth.

The muscular strength even of the healthier of the two classes of soldiers was doubtless somewhat inferior to that of the effectives of the army generally, the health of a portion of the men examined having been impaired. It is also probable, that the strength of effectives in active service is inferior to that of the same class at home engaged in the more congenial pursuits of civil life.

Quetelet gives the pressure which an average man can exert with both hands as somewhat over 70 kilogrammes (or 154 pounds avoirdupois); and with both arms his power in pulling as double that amount — the latter differing but little from the strength indicated above for the more healthy class of soldiers.

Professor Forbes, of the University of Edinburgh, has published, some years since, results of examinations with regard to the muscular strength of students of the age of 20 to 25 years, as tested by the dynamometer of Regnier. The mean of his results was about 390 pounds (or 177 kilogrammes).

An experimental acquaintance with the nature and the manner of using the different dynamometers employed is requisite to a satisfactory comparison of these results with the foregoing.

Capacity of the Chest. — Maximum Expiration Volume. A like disparity is observable in the relative chest capacity of the two classes, as tested by the spirometer, the average volume of maximum expiration of the more healthy class having been one hundred and ninety-four (194) cubic inches (or

3,18 cubic decimetres)*), and that of the less healthy one hundred and fifty-five (155) cubic inches (or 2,54 cubic decimetres); the latter volume being less than the former by about one-fifth.

In ascertaining the volume of maximum expiration it was required, that the lungs be inflated to their utmost extent, and then exhausted as completely as possible by breathing through the tube of the spirometer. The mean of three consecutive trials, by each man examined, was adopted as the required measure of volume.

The spirometer can indicate only the expiration-volume, not the entire capacity of the organs of respiration, a certain quantity of air always remaining in the lungs, and the air passages of the chest even after the most vigorous expiration.

According to Hutchinson the volume of maximum expiration is directly proportioned to the length of the body, and is independent of the circumference of the thorax.

Vierordt states the maximum expiration-volume of a man of average chest-capacity to be 3,2 cubic decimetres (or 195 cubic inches English) — nearly identical in amount with that above-mentioned of the healthier class of soldiers, — and the average volume of air remaining in the lungs after vigorous expiration to be 1,2 cubic decimetres (or 73 cubic inches); the entire capacity or maximum fulness, including the *residuum* being 4,4 cubic decimetres (or 268 cubic inches).

Frequency of Respiration. The respiration of the less healthy class was more frequent by one-fourth than that of the more healthy, — the average number of inspirations per minute of the former having been twenty and of the latter sixteen.

According to Quetelet, a person of the age of

from	15	to	20	years	will	breath	20	times	in	a minute,
»	20	»	25	»	»	»	19	»	»	»
»	25	»	30	»	»	»	16	»	»	»
»	30	»	50	»	»	»	18	»	»	»

The respiration may be voluntarily accelerated to the rate of 120 per minute.

It will be seen, that the respiration of the less healthy class of soldiers was somewhat more frequent, and that of the more healthy less frequent, than of civilians, according to this table, at the corresponding ages (25 and 23 years respectively).

Pulse. The pulse was slightly more frequent with the former class than with the latter, the average number of beats per minute having been respectively eighty and seventy-eight.

Even with the latter class it appears to have been more frequent than, according to Guy and others, with persons in civil life of corresponding age.

The examination and discussion of these physiological data are yet incomplete. From the observations made and in progress, it is believed that important conclusions may be elicited respecting the law, within certain limits of age, of the growth of man; also results, illustrating from various points of view, the relative characteristics of soldiers from different parts of the country, and of different races, nationalities, previous occupations, and social condition in other respects.

Nativities of Recruits.

In Table X, derived from Official records, are presented, subdivided into two classes (Eastern, and Western), the countries of birth of over twenty-six thousand (26 239) recruits to the volunteer forces of the United States. Of this number, ten thousand (9 835) were recruited from the North-Eastern States of Vermont, Connecticut, Massachusetts, and Rhode Island, and the remaining sixteen

*) 1 cubic decimetre = 61,027 cubic inches (English). 1 000 cubic inches = 16,386 cubic decimetres.

thousand (16 404) from the North-Western States of Indiana, Iowa, Michigan and Minnesota. The official returns from Iowa (as already stated with respect to height) embraced not only recruits to regiments subsequent to their formation, but also the members of regiments at the time of organization. The returns from the other States above-mentioned represent only men enlisting subsequently to the time when their respective regiments were organized; no returns, showing the nativities of the men constituting such regiments at the time of organization, having been deposited with the Department.

The above numbers — which constitute but a small portion of the whole number of volunteers — comprise all the official returns, since the commencement of the war, of the nativities of recruits, from the States specified, on file at the time of their examination in the Summer of 1863. Investigation of the returns of regiments from other States of the Union is in progress.

It will be seen that seven-tenths (69,8 per cent.) of the class of recruits from the four above-mentioned Eastern States, and seven-eighths (87,7 per cent.) of those from the four Western, were born in the United States of America; the remaining three-tenths and one-eighth respectively having been of Foreign birth. Hence the proportionate foreign element in the Eastern class of observations was about two and one-half times that of the Western.

Of such Eastern recruits, born in the United States, two-thirds were natives of the States respectively in which they were enlisted; of the Western, one-tenth only.

Of the Eastern class, including both foreign-born and native, seventeen and one-half per cent. (17,5) were natives of Ireland, five (4,9) of England and Scotland, four (3,9) of the British Dependencies, two and one-half (2,4) of Germany, and smaller proportions were natives of France and other countries.

Of the Western class, nearly three (2,8) per cent. were from Ireland, four (3,9) from England, Scotland and the British Dependencies, four (4,0) from Germany, and from other countries smaller proportions.

The British element appears to have been much greater with the Eastern than with the Western class; the German element, on the contrary, greater with the Western.

Comparison of these data, with the returns of the census of the year 1850, shows, that the proportionate number of foreign birth among the recruits, from the States above-specified, is greater than with the population of those States at the time of that enumeration. — The returns of the census of 1860 will doubtless show, when the classification according to nativities is published, a larger proportion of inhabitants of foreign birth than that of 1850.

Résumé and Conclusion.

In the foregoing has been exhibited from divers points of view, the varying state of the *personnel* of the volunteer forces of the United States in the existing war; presenting facts respecting age and other physiological features, together with, to some extent, an analysis of the laws which govern their distribution; and showing, for two different periods, the casualties, distinguished in divers ways, experienced by a vast army suddenly assembled, and commanded by officers, many of whom were at first as little acquainted with the duties which they were called upon to assume, as the volunteers in the ranks; also comparing, in part, such state, physiological and casual, with that of certain other armies and communities, American and European, in peace and in war.

The smaller rates of mortality observable, as compared with those of the other protracted wars cited, are believed to be due in no small degree to the organization, almost before the army had assembled, of systematic methods of inquiry, as to the condition and necessities of the soldier; of advice as to the best means of preventing the recurrence of evils, which — discerned by the light of the published experience of other armies in active service — were believed seriously to threaten the efficiency of the

new and inexperienced forces; and of timely and material relief to the sick and wounded soldiers, sustained by the voluntary and most liberal contributions in money and in kind, from the people of every part of the Loyal States.

Thanks to the searching investigations and efficient labors of the Herberts and the Nightingales, representatives of the practical philanthropy of Europe, new experiences of mortality from disease and of suffering were not needed to show the general character of the dangers which would beset the soldier; but the impending evils could, to an important extent, be anticipated, and, not unfrequently even before their presence was clearly manifest, proper means of prevention and remedy be applied.

By the institution — which cannot be too earnestly recommended — of still more exact and searching inquiries into the relative hygiènie condition of the several army-corps and their subdivisions, and by the frequent, regular and prompt publication of the results, the rates of sickness, invaliding, and mortality from disease, indicated by the foregoing data, would be sensibly reduced; the efficieney in point of numbers, vigor and *morale* of the forces in the field augmented; and the rate at which recruiting should progress, to supply continuous losses not only from deaths and invaliding, but from desertion, proportionately diminished.

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APPENDIX.

TABLES.
NOTE ON THE CONSTRUCTION OF CERTAIN TABLES.
DIAGRAMS.

Table I.

Showing the Annual Rates of Mortality of the Volunteer Forces, from different Sections of the United States, and for different Periods of the existing War, distinguishing Rank, and Cause of Death; derived from the Monthly Returns of Strength and Casualties made by the commanding Officers of Regiments to Adjutant-General.

The Eastern section includes the New England and Middle States, the States of Delaware, Maryland, and Virginia, and the District of Columbia; the Western section comprises the Western and South-Western States.

N. B. — The Rates are all reduced to the basis of a Year, as the unit of time.

Cause of Death.		Annual Death-rates per 1 000 average Strength.					
		Nine earlier Months of the War, June 1861 to February 1862 (inclusive).			Succeeding Six Months, March 1862 to August 1862 (inclusive).		
		Officers and Men.	Commissioned Officers.	Enlisted Men.	Officers and Men.	Commissioned Officers.	Enlisted Men.
Aggregate, Eastern and Western	All Causes	53,2	33,2	54,0	92,9	90,4	93,2
	Wounds received in Action (including killed on the field)	8,6	11,4	8,5	33,2	47,8	32,7
	Diseases and accidents	44,6	21,8	45,5	59,7	42,6	60,5
Eastern Forces	All Causes	31,6	21,0	32,1	66,1	73,4	66,0
	Wounds received in Action	3,8	5,0	3,7	27,9	38,0	27,6
	Diseases and accidents	27,8	16,0	28,4	38,2	35,4	38,4
Western Forces	All Causes	95,0	58,8	96,4	120,3	107,7	121,0
	Wounds received in Action	18,2	24,5	17,9	38,6	57,7	37,9
	Diseases and accidents	76,8	34,3	78,5	81,7	50,0	83,1

EXAMPLE. *The Mortality of the Volunteer Soldiers (including officers and men) from the Eastern portion of the United States, during the six months March 1862 to August 1862 (inclusive), from all causes, was at the Annual Rate of sixty-six (66,1) per 1 000 of their average numerical strength; twenty-eight (27,9) having been killed in action or died of wounds received therein, and thirty-eight (38,2) having perished from diseases or accidents.*

Table II.

Showing the Constant Rates of Sickness for different Periods of the existing war, experienced by the Officers and Men, Present and Absent, of those Regiments of the United States Volunteer Forces, from different Sections of the country, which have furnished Monthly Returns of Strength and Casualties to the Adjutant-General.

		Average Constant Number of Sick to 1 000 numerical Strength.					
		For the nine months, June 1861 to February 1862 (inclusive)			For the six months, March 1862 to August 1862 (inclusive)		
		Present and Absent.	Present.	Absent.	Present and Absent.	Present.	Absent.
Aggregate: Eastern and Western	Officers and Men	**104**	83	397	**169**	78	607
	Commissioned Officers	69	53	181	108	68	280
	Enlisted Men	106	84	414	172	78	623
Eastern Forces	Officers and Men	**76**	64	277	**128**	64	521
	Commissioned Officers	57	45	150	92	62	235
	Enlisted Men	77	65	290	129	65	537
Western Forces	Officers and Men	**161**	123	544	**211**	92	666
	Commissioned Officers	94	72	243	124	75	318
	Enlisted Men	163	125	562	214	93	681

EXAMPLE. *The average constant number of sick for the six months, from March to August 1862 (inclusive), of commissioned officers serving with the Western volunteer forces of the United States, compared with their entire number, both present and absent, was 124 per 1 000. The number of officers sick, of the same forces and period, present with their regiments, to the whole number of officers present, was 75 per 1 000; the number of officers sick absent from their regiments, to the whole number of officers absent, was 318 per 1 000.*

Table III.

Constant Sickness-rates of the Army of the Potomac, at different Dates from October 31st 1862 to March 31st 1863, inclusive, — deduced from the Consolidated Returns of the Commanding General, made three times a month.

In the returns previous to that of November 30th 1862, the number of sick absent from the Army, was not specified.

Date.	Locality of Camp.	Name of the Major-General Commanding.	Constant Sick								
			Present and Absent, to Strength Present and Absent, per 1 000.			Present, to Strength Present, per 1 000.			Absent, to Strength Absent, per 1 000.		
			Officers and Men.	Commissioned Officers.	Enlisted Men.	Officers and Men.	Commissioned Officers.	Enlisted Men.	Officers and Men.	Commissioned Officers.	Enlisted Men.
1862											
October 31	Near Knoxville, Maryland,	Geo. B. M'Clellan	.	.	.	92	53	94	.	.	.
November 10	» Warrenton, Virginia,	A. E. Burnside	.	.	.	80	42	81	.	.	.
» 25	» Falmouth, »	»	.	.	.	107	53	110	.	.	.
» 30	» » »	»	126	57	129	118	58	121	146	53	149
December 10	» » »	»	185	85	190	108	63	110	414	159	425
» 20	» » »	»	218	115	223	115	72	115	486	240	495
» 31	» » »	»	229	124	234	114	73	116	549	276	561
1863											
January 10	» » »	»	243	129	248	117	71	119	598	298	613
» 20	» » »	»	240	120	245	110	66	113	603	276	618
» 31	» » »	Joseph Hooker	239	117	245	111	64	113	589	264	605
February 10	» » »	»	.	.	.	.	.	.	.	.	.
» 20	» » »	»	226	110	232	75	55	76	605	225	628
» 28	» » »	»	220	103	226	84	55	85	584	222	605
March 10	» » »	»	209	97	215	83	58	85	561	198	583
» 20	» » »	»	195	99	200	79	58	80	549	206	570
» 31	» » »	»	179	88	184	73	55	74	513	183	533

Table IV.

Showing the Annual Rates of Regimental Gain and Loss to the Enlisted Men — comprising non-commissioned officers and privates — of the Volunteer Forces of the United States from different Sections of the Country, and for different Periods of the existing War; according to the Monthly Returns from Regiments in the Bureau of the Adjutant-General.

Gain from Recruits and Loss by reason of Expiration of the Term of Service are not included.

N. B. — The rates are all reduced to the basis of a Year, as the unit of time.

Casualties.	Annual Rates per 1 000 Enlisted Men:					
	For the Nine Earlier Months of the War. June 1861 to February 1862 (inclusive).			For the Six Later Months. March to August 1862 (inclusive).		
	Gain.	Loss.	Excess of Loss over Gain.	Gain.	Loss.	Excess of Loss over Gain.
Died	.	54	54	.	93	93
Discharged (not including for Expiration of term of Service)	.	100	100	.	145	145
Deserted, and Returned from Desertion	6	56	50	10	77	67
Missing in Action	1	15	14	7	47	40
Other Causes (specified and unspecified) — as Promoted, Dropped, »Error« etc.	4	8	4	8	13	5
Total (exclusive of Gain from Recruits, Loss because of Expiration of the Term of Service, and Gain and Loss by Transfer,	11	233	222	25	375	350
Transferred	53	60	7	29	26	—3*)

*) Excess of Gain over Loss.

Example. *The average Excess of Loss over Gain — exclusive of Gain by Recruits of Loss by reason of Expiration of the Term of Service, and of Gain and Loss by Transfer — to the Enlisted Men (embracing non-commissioned officers and privates) of the Regiments in the Volunteer Service of the United States which have made monthly returns to the Bureau of the Adjutant-General, was, during the Six Months from March to August 1862 inclusive, at the Annual Rate of 350 for every 1 000 Men; of which number, 93 represents the Loss by Death, 145 the Loss by Discharged from Service (exclusive of Discharged for Expiration of its Term), 67 the Excess from Desertion over Return of Deserters to duty, 40 the Excess from Missing in Action not subsequently accounted for, and 5 the Excess from Other Causes specified and unspecified. — The Excess of Gain over Loss by Transfer was 3 per 1 000.*

Table V.

Showing the Distribution of the Ages of Volunteers from the State of Massachusetts for the existing War, at the dates of the acceptance of their Regiments by the General Government (not including Recruits joining subsequently), derived from Official Returns in the Bureau of the Adjutant-General; and comparison of the same with the results of Calculation.

Number of Observations..... 51 271.
Average Age..... 25.99 years.

Age (last birth-day).	Numbers in each Year of Age.	Numbers at and over Specified Ages.	Proportion at and over Specified Ages		Proportion in each Year of Age		Differences betwen Observed and Calculated Values in each Year of Age.
			Observed.	Calculated.	Observed.	Calculated.	
1.	2.	3.	4.	5.	6.	7.	8.
Years.							
12	4	51 271	10 000	10 000	1		
13	4	51 267	9 999	.	1		
14	26	51 263	9 998	.	5	208	— 117
15	44	51 237	9 993	.	8		
16	101	51 193	9 985	.	20		
17	289	51 092	9 965	.	56		
18	6 396	50 803	9 909	9 792	1 248	1 131	+ 117
19	4 331	44 407	8 661	8 661	844	986	— 142
20	3 482	40 076	7 817	7 675	680	862	— 182
21	5 020	36 594	7 137	6 813	979	755	+ 224
22	3 661	31 574	6 158	6 058	714	662	+ 52
23	3 060	27 913	5 444	5 396	597	582	+ 15
24	2 721	24 853	4 847	4 814	530	513	+ 17
25	2 349	22 132	4 317	4 301	458	454	+ 4
26	2 118	19 783	3 859	3 847	414	402	+ 12
27	1 826	17 665	3 445	3 445	356	358	— 2
28	1 919	15 839	3 089	3 087	374	320	+ 54
29	1 300	13 920	2 715	2 767	254	287	— 33
30	1 464	12 620	2 461	2 480	285	259	+ 26
31	929	11 156	2 176	2 221	181	234	— 53
32	1 161	10 227	1 995	1 987	227	213	+ 14
33	977	9 066	1 768	1 774	191	195	— 4
34	914	8 089	1 577	1 579	177	179	— 2
35	1 120	7 175	1 400	1 400	220	166	+ 54
36	692	6 055	1 180	1 234	135	154	— 19
37	640	5 363	1 045	1 080	125	144	— 19
38	745	4 723	920	936	145	135	+ 10
39	551	3 978	775	801	108	127	— 19
40	765	3 427	667	674	148	121	+ 27
41	398	2 662	519	553	77	115	— 38
42	586	2 264	442	438	115	111	+ 4
43	537	1 678	327	327	106	106	0
44	761	1 141	221	221	147	103	+ 44
45	280	380	74	118	54	100	— 46
46	28	100	20	18	6		
47	14	72	14	.	3		
48	16	58	11	.	3	18	+ 2
49	9	42	8	.	2		
50 and over.	33	33	6	.	6		
Total	51 271	743 191	144 944	.	10 000	10 000	.

EXAMPLE. *Of 51 271 Massachusetts Volunteers (regimental officers and men together), according to official returns, 2 349 were between the ages of 25 and 26 years; and the entire number, at and over the age of 25 years was 22 132. For every 10 000 Volunteers entering the service, the proportion at and over this age, according to observation was 4 317, and according to calculation 4 301; the proportion in this year of age (that is, from age 25 to age 26) was, according to observation 458, and calculation 454 — the observed result exceeding the calculated by 4.*

In determining the average age, estimated allowance is made for the probable diminution with advancing age, of the numbers distributed within the several year-intervals; and also for the distribution of the numbers over the age of 50 years.

FORMULAS. The values in column 7, from age 18 to 45 inclusive, — showing approximately the proportionate numbers in each year of age — are in accordance with the following Formula x denoting the Age,

$$80 \cdot 4 + 906 \times 0 \cdot 8626^{x-19}.$$

The form of this expression is that of the sum of a series progressing by a common ratio, 0·8626 being the ratio for an annual interval of age.

The values in column 5, within the same limits of age — sums of the numbers at and over specified ages in column 7 — may be derived from the following formula;

$$2067 - (x-19) \times 80 \cdot 4 + \frac{906}{1-0 \cdot 8626} \times 0 \cdot 862^{x-19};$$

or its simpler equivalent,

$$2067 - (x-19) \times 80 \cdot 4 + 6593 \cdot 9 \times 0 \cdot 8626^{x-19}.$$

The identity of the observed and calculated values in columns 4 and 5, corresponding to the equi-distant ages of 19, 27, 35 and 43 years respectively, was assumed, in determining the constants in the above formulas.

Table VI.

Comparing the Observed with the Theoretical Distribution, as to Height, of Recruits to the Volunteer Forces of the United States for the existing War — according to Data, derived from Official Returns in the Bureau of the Adjutant-General.

Number of Observations 25,878; about two-fifths of the Recruits measured being from the North-Eastern (or New England) States, and the remaining three-fifths from the North-Western States of Iowa, Indiana, Michigan, and Minnesota.

Measures of Height.		Number of Recruits at each Height.	Proportion at each Height of 1 000 Recruits Measured.		Differences between the Observed and Calculated values.
Inches (English).	Decimetres.	From ½ inch below to ½ inch above the Specified Height.	Observed.	Calculated.	
55 and under	13,97 and under	4			
56	14,22	1			
57	14,48	3	1	2	− 1
58	14,73	7			
59	14,99	6			
60 (5 feet)	15,24	10			
61	15,49	15	1	3	− 2
62	15,75	50	2	9	− 7
63	16,00	526	20	21	− 1
64	16,26	1 237	48	42	+ 6
65	16,51	1 947	75	72	+ 3
66	16,76	3 019	117	107	+ 10
67	17,02	3 475	134	137	− 3
68	17,27	4 054	157	153	+ 4
69	17,53	3 631	140	146	− 6
70	17,78	3 133	121	121	0
71	18,03	2 075	80	86	− 6
72 (6 feet)	18,29	1 485	57	53	+ 4
73	18,54	680	26	28	− 2
74	18,80	343	13	13	0
75	19,05	118	5	5	0
76	19,30	42	2	2	0
77	19,56	9			
78	19,81	6	1	0	+ 1
79	20,07	2			
	Total.....	25 878	1 000	1 000	− 28 + 28

Average Height five feet eight and one-fifth inches (68,20 inches), or 17,32 decimetres.

Average Variation below the Average Height, 2,03 inches, or 0,52 of a decimetre.

Average Variation above the Average Height, 2,10 inches, or 0,53 of a decimetre.

Mean Variation from the Average Height, 2,066 inches, or 0,525 of a decimetre: which is the one thirty-third part (or 3,03 per cent.) of the Average Height.

The Modulus of Convergence $\left(\frac{0,56419}{\text{Mean Variation}}\right)$ corresponding to the Mean Variation — or the constant Factor, which (assuming the law of probability strictly to obtain) multiplied into the difference between the above-specified Measures of Height and the Average Height, will give the corresponding Argument in the published Table showing the Probable Distribution of Errors of Observation, or of casual Variations from a Type (and represented by the function $\frac{2}{\sqrt{\pi}}\int^{t} e^{-t^2}dt$, t denoting the Argument) — is, for inches 0,2731, and for decimetres 1,075.

Table VII.

Height of Soldiers of the Army of the Potomac, — at the Convalescent Camp, near Alexandria, Virginia; — according to Records of Measurements conducted by the Sanitary Commission.

Observed and Calculated Proportions compared.

Number of Observations **761**; the Men examined being mainly from the North-Eastern and the Middle States of the Union.

Measures of Height.		Number of Observations at each Height.	Proportion at each Height to 1 000 Observations.			Differences between the Proportions Observed and Calculated.	
Inches (English).	Decimetres.	From ½ inch below to ½ inch above the Specified Height.	Observed.	Calculated. First Method.	Calculated. Second Method.	Columns (4) and (5).	Columns (4) and (6).
1.	2.	3.	4.	5.	6.	7.	8.
58	14,73	.	.	.	.	.	.
59	14,99	.	.	1	.	— 1	.
60 (5 feet)	15,24	1	1	4	2	— 3	— 1
61	15,49	6	8	11	7	— 3	+ 1
62	15,75	11	14	24	21	— 10	— 7
63	16,00	37	49	45	47	+ 4	+ 2
64	16,26	83	109	75	81	+ 34	+ 28
65	16,51	71	93	109	116	— 16	— 23
66	16,76	104	137	137	139	0	— 2
67	17,02	113	148	150	147	— 2	+ 1
68	17,27	105	138	142	136	— 4	+ 2
69	17,53	85	112	117	113	— 5	— 1
70	17,78	75	99	84	83	+ 15	+ 16
71	18,03	34	45	52	54	— 7	— 9
72 (6 feet)	18,29	19	25	28	31	— 3	— 6
73	18,54	11	14	13	15	+ 1	— 1
74	18,80	5	7	5	6	+ 2	+ 1
75	19,05	1	1	2	2	— 1	— 1
76	19,30	.	.	1	.	— 1	.
77	19,56	.	.	.	.	.	.
	Total	761	1 000	1 000	1 000	+ 56 — 56	+ 51 — 51

Average Height five feet seven and one-eighth English inches (67,13 inches), or 17,05 decimetres.

Average Variation below the Average Height, 2,09 inches, or 0,53 of a decimetre.

Average Variation above the Average Height, 2,13 inches, or 0,54 of a decimetre.

Mean Variation from the Average Height, two and one-ninth (2,11) inches, or 0,536 of a decimetre; — which is the one thirty-second part (or 3,15 per cent.) of the Average Height.

The Modulus $\left(\frac{0{,}56419}{\text{Mean Variation}}\right)$, is for inches 0,2669, and for decimetres 1,051.

Table VIII.

Circumference of the Chests of Soldiers in the Army of the Potomac; — Observed and Calculated Proportions compared.

Measurements conducted by the Sanitary Commission.

Number of Observations **1516.**

Measures of Circumference.		Number at each Measurement.	Proportion at each Measurement to 1 000 Observations.		Differences between the Observed and the Calculated Proportions.
Inches (English).	Decimetres.		From one-half inch within, to one-half inch beyond the specified Measurement		
			Observed.	Calculated.	
28 (2⅓ feet)	7,11	2	1	1	0
29	7,37	4	3	3	0
30	7,62	17	11	11	0
31	7,87	55	36	32	+ 4
32 (2⅔ feet)	8,13	102	67	69	— 2
33	8,38	180	119	121	— 2
34	8,64	242	160	170	— 10
35	8,89	310	204	190	+ 14
36 (3 feet)	9,14	251	166	169	— 3
37	9,40	181	119	120	— 1
38	9,65	103	68	68	0
39	9,91	42	28	31	— 3
40 (3⅓ feet)	10,16	19	13	11	+ 2
41	10,41	6	4	3	+ 1
42	10,67	2	1	1	0
	Total	1 516	1 000	1 000	— 21 + 21

Average Circumference of the Chest, thirty-five (34,99) English inches, or 8,89 decimetres.

Average Variation therefrom in Defect, 1,67 inches, or 0,424 of a decimetre.

Average Variation therefrom in Excess, 1,65 inches, or 0,419 of a decimetre.

Mean Variation from the Average Circumference, one and two-thirds (1,66) inches, or 0,422 of a decimetre; — which is equal to $\frac{1}{21}$ (or four and three-fourths (4,74) per cent.) of such Average Circumference.

The Modulus of Convergence $\left(\frac{0,56419}{\text{Mean Variation}}\right)$ — or, the constant Factor, which multiplying the difference between the above-specified Measures of Circumference and the Average Circumference, will give the corresponding Argument in the published Table showing the Probable Distribution of Errors of Observation, or of accidental Variations from a Type, — is, for inches 0,340, and for decimetres 1,338.

Table IX.

Exhibiting certain Physiological Characteristics of a Portion of the Volunteer Soldiers of the Army of the Potomac.

Results of individual inspection conducted by the Sanitary Commission.

Subjects of Inquiry.	Averages of Observations			
	at the Convalescent Camp, near Alexandria, Virginia.		at Aquia-Creek Landing, Virginia. Mainly Effectives.	
Age — last birthday	25 years		23 years	
	Inches	*Decimetres*	*Inches*	*Decimetres*
Entire Height — in stockings	67,13	17,05	67,0	17,0
Height from ground to lower part of Neck (7th cervical vertebra)	57,3	14,6	57,0	14,5
Height to Perinæum	30,6	7,8	31,1	7,9
Length of Arm — from arm pit to tip of middle finger.	28,2	7,2	28,2	7,2
Breadth of Neck	4,1	1,04	4,0	1,02
Breadth at the Shoulders	16,5	4,2	16,3	4,1
Breadth at the Pelvis	13,4	3,4	13,1	3,3
Circumference of Chest — over the nipple, under the coat and waistcoat	35,1	8,9	34,9	8,9
Circumference of Waist	32,7	8,3	32,0	8,1
Head — Circumference about Frontal Eminence and greatest Projection of Occiput	22,1	5,6	22,3	5,7
Head — Distance between the Condyloid Processes of the lower jaw over the Os Frontis — longest measurement	11,5	2,9	11,2	2,8
Head — Distance between Condyloid Processes, over the Parietal Bones	12,8	3,25	13,1	3,3
Head — Distance from Frontal Eminence to Protuberance of Occiput	14,3	3,6	14,0	3,6
Eyes — Distance between the Pupils	2,6	0,7	2,6	0,7
Foot — Length	10,2	2,6	10,0	2,5
Foot — Circumference over Instep	13,4	3,4	13,2	3,3
Capacity of Chest*) — Maximum Expiration - volume	155 *cub. inch.*	2,54 *litres*	194 *cub. inch.*	3,18 *litres*
Weight — without coat, hat, arms, or accoutrements.	148 *lbs.*	67,1 *kilogr.*	147 *lbs.*	66,7 *kilogr.*
Dynamometer	260 »	117,9 »	298 »	135,1 »
Pulse, regular — beats per minute	80		78	
Respiration — inspirations per minute	20		16	
Facial Angle — degrees	74		78	

*) Not including the volume of air remaining in the lungs after vigorous expiration.

Table X.

Showing the Distribution as to Nativity of 26 239 Recruits to the Volunteer Forces of the United States, — comprised of 9 835 from the North-Eastern States of Vermont, Massachusetts, Rhode Island and Connecticut, and of 16 404 from the North-Western States of Indiana, Iowa, Michigan and Minnesota.

Where Born.		Numbers, to each Place of Birth, of Recruits from the States of		Proportion, to each Place of Birth, of 1000 Recruits from the States of	
		Vermont, Massachusetts, Rhode Island and Connecticut.	Indiana, Iowa, Michigan and Minnesota.	Vermont, Massachusetts, Rhode Island and Connecticut.	Indiana, Iowa, Michigan and Minnesota.
United States	In the State where Enlisted	4 628	1 464	470	89
	» Other of United States	2 240	12 935	228	788
Foreign Countries	» Ireland	1 722	450	175	28
	» England	369	352	38	21
	» Scotland	110	65	11	4
	» the British Dependencies	378	226	39	14
	» Germany	239	650	24	40
	» France	61	28	6	2
	» Other Countries	88	234	9	14
Total Born in the United States		6 868	14 399	698	877
» » Elsewhere		2 967	2 005	302	123
Aggregate — Native and Foreign		9 835	16 404	1 000	1 000

Note.

On the Construction of Certain Tables.

According to theory, the probable number of individuals representing a type, corresponding to any specified measurement, x, may be represented by

$$\frac{Nh}{\sqrt{\pi}} e^{-h^2 (x-k)^2} dx,$$

and the probable number in the unit-interval, between the varying measurements $x - \frac{1}{2}$ and $x + \frac{1}{2}$, by

$$\frac{Nh}{\sqrt{\pi}} \int_{x-\frac{1}{2}}^{x+\frac{1}{2}} e^{-h^2 (x-k)^2} dx;$$

N denoting the entire number of observations, k the average measurement, e (=2,71828...) the base of the Napierian (or natural) system of logarithms, h the »modulus of convèrgence«, and π (=3.14159...), the ratio of the circumference of a circle to its diameter.

These two forms give values nearly identical; those furnished by the former, however being somewhat the greater in the vicinity of the average measurement (where, if represented by rectangular coordinates, the curve joining the extremeties of the ordinates is concave towards their origin), and slightly less at all other points.

Where the operation of the law of probability, which controls the distribution, is undisturbed, the modulus h, is equal to $\frac{1}{\varrho\sqrt{\pi}}$; ϱ denoting the mean variation from the average measurement.

$$\frac{1}{\sqrt{\pi}} = 0{,}564189...$$

Tabulated values of the function $\frac{2}{\sqrt{\pi}} \int_0^t e^{-t^2} dt$, have already been published with greater or less completeness in several works on probabilities. The Tabulated series, to which in the present case it has been found convenient to refer, is in the Appendix to Prof. De Morgan's treatise on Probabilities, in Lardner's Cabinet Cyclopædia.

It is proposed to compare the actual distribution, as to height, of a portion of the soldiers in the Army of the Potomac, with that demanded by the Theory of Probabilities, and with an adjustment of the irregularities of the observed valnes. The number of observations (761) employed for the illustration, although not large, is sufficient for the purpose in view, — of exhibiting the process of computation and of illustrating the law which governs the distribution.

Construction of Table A. In the construction of Table A,

let ϱ' denote the average variation in defect,

ϱ'', the average variation in excess,

ϱ, denoting, as already employed, the mean variation from the average height, or the half-sum of the variations in excess and defect.

The numbers in column 4, are sums of those in column 2; and those in column 5, sums of those in column 4.

If, for the numbers 313, 113 and 335 in columns 2 and 4, we put A, B and C respectively,

(observing that 313 and 335 are each less than one-half of 761 the entire number of observations), and for 741 and 840 in column 5 we put E and F, and for $\frac{1}{2}\ (\frac{1}{2}-a)\ (\frac{1}{2}+a)\ B$ put G, we shall have,

$$a = \frac{F-E}{A+B+C},\ k = 67+a,$$

$$\varrho' = \frac{E+G}{A+(\frac{1}{2}+a)\,B}+a,$$

$$\varrho'' = \frac{F+G}{C+(\frac{1}{2}-a)\,B}-a,\ \text{and}\ \varrho = \frac{\varrho'+\varrho''}{2}$$

Substituting, for the symbols in these equations, their values as above-given, we readily obtain

$a = 0{,}1301$ of an inch.

$k = 67+a = 67{,}1301$ inches (or 5 feet $7\frac{1}{8}$ inches), the average height.

$G = 13{,}1687$.

$\varrho' = 2{,}0931$ inches.

$\varrho'' = 2{,}1341$ inches.

and

$\varrho = 2{,}1136$ inches, the mean variation from the average height.

This mean variation is about the one thirty-second $(\frac{1}{32})$ part (or 3,15 per cent) of the average height.

In calculating, by this process, the average height and the average variations therefrom, it is assumed that the numbers in each interval of height are uniformly distributed throughout the interval. As the numbers were not actually so distributed, but as a rule, diminished as they receded from the average height, the average variations above-given are each in excess by a small fraction of an inch; a deviation unimportant in amount*). The average height, however, so calculated, is not subject to inaccuracy from this source, the slight errors of excess and defect balancing each other, or nearly so.

It will be observed that the average variation in defect is slightly less (0,04 of an inch) than that in excess. We have no records showing the number rejected for defect of height, but inspection of the data as to those accepted, indicates, that the proportionate number so rejected must be small; and it is believed, that, if definitely ascertained, their addition to the number of accepted at the same heights, would not, to an important extent, augment the mean variation, or diminish the average height.

Assuming then, the Modulus, h, to be equal to $\frac{1}{\varrho\sqrt{\pi}}$, — the relation demanded by theory when the distribution is free from arbitrary interference — its numerical value becomes, for the data under consideration, $\frac{0{,}564189}{2{,}1136}$ or 0,26693.

From h and k are found values of $t-\frac{1}{2}h$, or its equivalent $h\,(x-\frac{1}{2}-k)$, in column 6, corresponding to the specified values of x in column 1. h is the common difference, and one value in the series having been ascertained, the remaining values are readily found by the successive addition or subtraction therefrom of h, or its numerical equivalent, 0,26693.

The values in column 7, were found by entering the published Table of Probability with the values in column 6, as arguments.

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*) The average variations in defect and excess may be represented with greater exactness, by subtracting from their respective values above given,

$\frac{1}{24}$ of $\frac{b+B}{A+(\frac{1}{2}+a)\,B}$, for the average variation in defect,

and

$\frac{1}{24}$ of $\frac{B+b'}{C+(\frac{1}{2}-a)\,B}$, for that in excess;

in which b and b' are put respectively for 104 and 105 (the numbers nearest B, above and below, in column 2), the remaining symbols denoting as already given above.

The values in column 8 are the half-differences of those in column 7 multiplied by 1000; and are identical with the first series of calculated values in Table VII, column 5.

Construction of Table B. In arriving at the second series, that of adjusted values (Table VII, column 6), the following process was adopted:

Column 2 in Table B, exhibits the proportion of the whole number examined, in each of the several inch-intervals of which the specified height is the middle. Column 3 shows the sums of the proportions at and under specified heights, less one-half of unity (0,5000).

The arguments corresponding to those values doubled (in column 4) were then taken, by inverse entry, from the published table of probability. Only the arguments corresponding to the equidistant heights of $61\frac{1}{2}$, $65\frac{1}{2}$, $69\frac{1}{2}$ and $73\frac{1}{2}$ inches (column 5) were retained. In the absence of disturbing elements, theory demands that the first differences of these arguments should be constant. They are, however, not strictly equal, being respectively 1243, 1043, and 1086; the first of these differences being the largest, but the second and third nearly identical. A simple algebraical expression, one with constant third differences, was then assumed to connect these four numbers, and therefrom was derived a new and regular series of argument values. With this new series the Table of Probability was again entered, and proceeding as in the construction of Table A (just described), the calculated proportions at each height in column 6 were obtained.

The results by the latter method of construction approximate more closely to the observed data than those by the former, especially for the lesser heights.

Table A.

Distribution, as to Height, of a portion of the Soldiers in the Army of the Potomac; — Observed and Calculated.

First Method of Calculation.

Measures of Height	Number of Observations at each Height	Proportion at each Height to 1000 Observations	Sums of Numbers in (2)	Sums of Numbers in (4)	Argument; or Rank in the General Table of Probability	Probability, according to the General Table	Calculated: Proportion at each Height to 1000 Observations	Calculated: Number at each Height to 761 Observations	Differences between Calculated and Observed Results in Columns (2) and (9)
x	From Height $x-\frac{1}{2}$ to $x+\frac{1}{2}$				$h(x-\frac{1}{2}-k) = t-\frac{h}{2}$	$\frac{2}{\sqrt{\pi}}\int_0^{t-\frac{1}{2}h} e^{-t^2}dt$	$\frac{1000}{\sqrt{\pi}}\int_{t-\frac{1}{2}h}^{t+\frac{1}{2}h} e^{-t^2}dt$	$\frac{761}{\sqrt{\pi}}\int_{t-\frac{1}{2}h}^{t+\frac{1}{2}h} e^{-t^2}dt$	
1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
Inches									
58	.	.	.	.		− 1,00000	0,6	½	− ½
59	.	.	.	.	− 2,3037	− 0,99888	1,4	1	− 1
60 (5 feet)	1	1,3	1	.	− 2,0368	− 0,99603	4,2	3	− 2
61	6	7,9	7	.	− 1,7698	− 0,98768	10,6	8	− 2
62	11	14,4	18	.	− 1,5029	− 0,96645	23,5	18	− 7
63	37	48,6	55	.	− 1,2360	− 0,91953	45,1	34	+ 3
64	83	109,1	138	.	− 0,9690	− 0,82943	75,1	57	+ 26
65	71	93,3	209	.	− 0,7021	− 0,67924	108,8	83	− 12
66	104	136,7	313	741	− 0,4351	− 0,46165	136,8	104	0
67	113	148,5			− 0,1682	− 0,18801	149,5	114	− 1
68	105	138,0	335	840	+ 0,0987	+ 0,11101	142,0	108	− 3
69	85	111,7	230	.	+ 0,3657	+ 0,39496	117,0	89	− 4
70	75	98,5	145	.	+ 0,6326	+ 0,62901	83,8	64	+ 11
71	34	44,7	70	.	+ 0,8996	+ 0,79671	52,1	40	− 6
72 (6 feet)	19	25,0	36	.	+ 1,1665	+ 0,90099	28,2	22	− 3
73	11	14,4	17	.	+ 1,4334	+ 0,95735	13,2	10	+ 1
74	5	6,6	6	.	+ 1,7004	+ 0,98381	5,4	4	+ 1
75	1	1,3	1	.	+ 1,9673	+ 0,99461	1,9	1	0
76	.	.	.	.	+ 2,2343	+ 0,99842	0,6	½	− ½
77	.	.	.	.	+ 2,5012	+ 0,99959	0,2		
78	.	.	.	.		+ 1,00000			
All Heights	761	1000,0	.	.	.	.	1000,0	761	− 42 + 42

Table B.

Distribution as to Height of a portion of the Soldiers in the Army of the Potomac; — Observed and Calculated.

Second Method of Calculation.

Measures of Height. Inches.	Observed Proportion from ½ inch below to ½ inch above the specified Height.	Sums of Numbers in Column (2), less, 0,5000.	Values in Column (3), Doubled.	Corresponding Argument or Rank in the Table of Probability.	Calculated Proportion from ½ inch below to ½ inch above the specified Height.
1.	2.	3.	4.	5.	6.
60 (5 feet)	0,0013	— 0,5000	— 1,0000	..	0,0020
61	0,0079	— 0,4987	— 0,9974	..	0,0072
62	0,0144	— 0,4908	— 0,9816	— 1,667	0,0214
63	0,0486	— 0,4764	— 0,9528	..	0,0471
64	0,1091	— 0,4278	— 0,8556	..	0,0814
65	0,0933	— 0,3187	— 0,6374	..	0,1160
66	0,1367	— 0,2254	— 0,4508	— 0,424	0,1389
67	0,1485	— 0,0887	— 0,1774	..	0,1465
68	0,1380	+ 0,0598	+ 0,1196	..	0,1362
69	0,1117	+ 0,1978	+ 0,3956	..	0,1128
70	0,0985	+ 0,3095	+ 0,6190	+ 0,619	0,0832
71	0,0447	+ 0,4080	+ 0,8160	..	0,0542
72 (6 feet)	0,0250	+ 0,4527	+ 0,9054	..	0,0306
73	0,0144	+ 0,4777	+ 0,9554	..	0,0146
74	0,0066	+ 0,4921	+ 0,9842	+ 1,707	0,0057
75	0,0013	+ 0,4987	+ 0,9974	..	0,0022
		+ 0,5000	+ 1,0000	..	
.	1,0000	..	..	..	1,0000

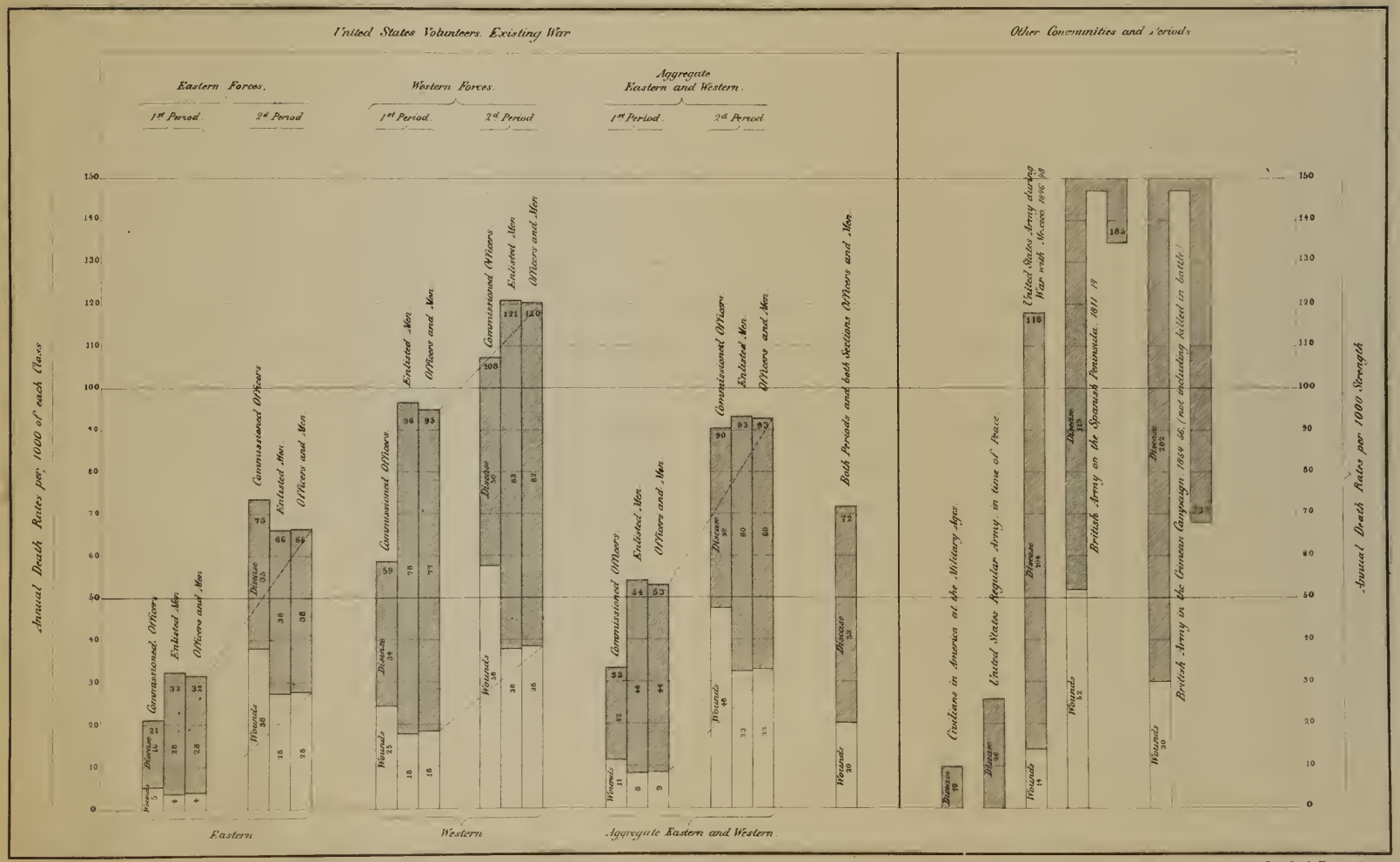
International Statistical Congress at Berlin, 1863

Military Statistics of the United States of America

Diagram A.

Showing the **Death rates** from Wounds received in Action, and from Diseases and Accidents of Commissioned Officers and of Enlisted Men of such Eastern and Western Volunteer Regiments of the United States Army, as have made Monthly Returns of Casualties to the Department of War, for the Periods of **Nine Months**, from June 1861 to February 1862 (inclusive), and of **Six Months**, from March to August 1862, inclusive); also, comparing the above with certain other Death-rates, American and European, in Peace and in War.

N.B. The Rates are all reduced to the Basis of a **Year**, as the Unit of Time.



Fec E.B.Elliott

Engr by L. Fraatz Berlin

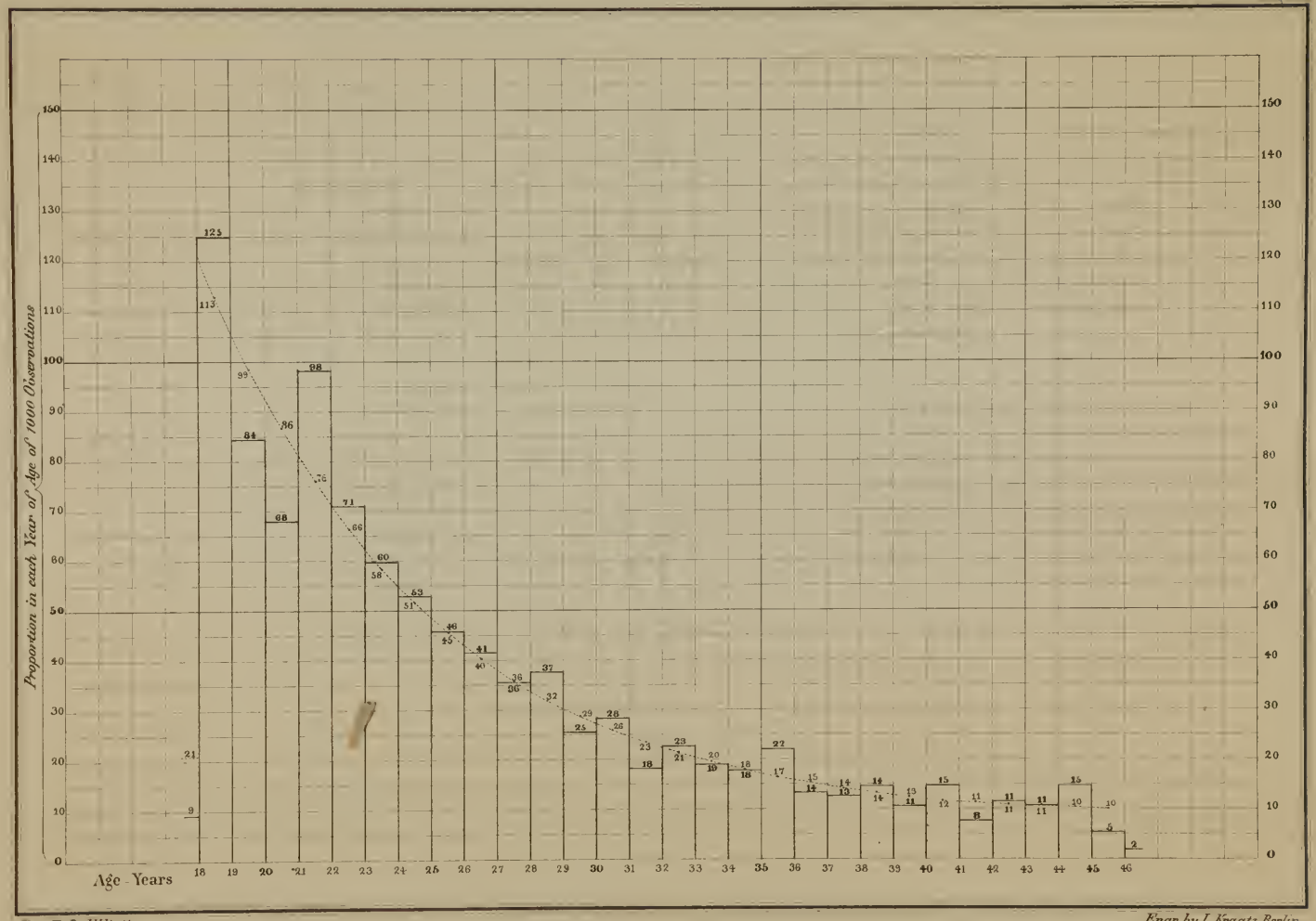
In the first period the Eastern regiments constituted nearly two thirds (64 per cent) of the whole force returned in the monthly reports, in the second, about one half (51 per cent).

International Statistical Congress at Berlin 1863.

Military Statistics of the United States of America.

Diagram B,

representing the **Distribution** as to **Age**, of 51,271 Soldiers from the State of Massachusetts, according to **Official** Records, also Comparing these Results of Observation with Theoretical Values calculated on the assumption that the Differences of the Numbers in the several consecutive Years of Age diminish by a common Ratio. The Numbers are proportioned to the Basis of 1000 Observations.



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The Parallelograms represent the results of Observation.

The Continuous Line, a Logarithmic Curve, indicates the results of Calculation.

The Formula of Construction is $80{,}4 + 906 \times \frac{}{0{,}8626}^{x-19}$, *x denoting the Age.*

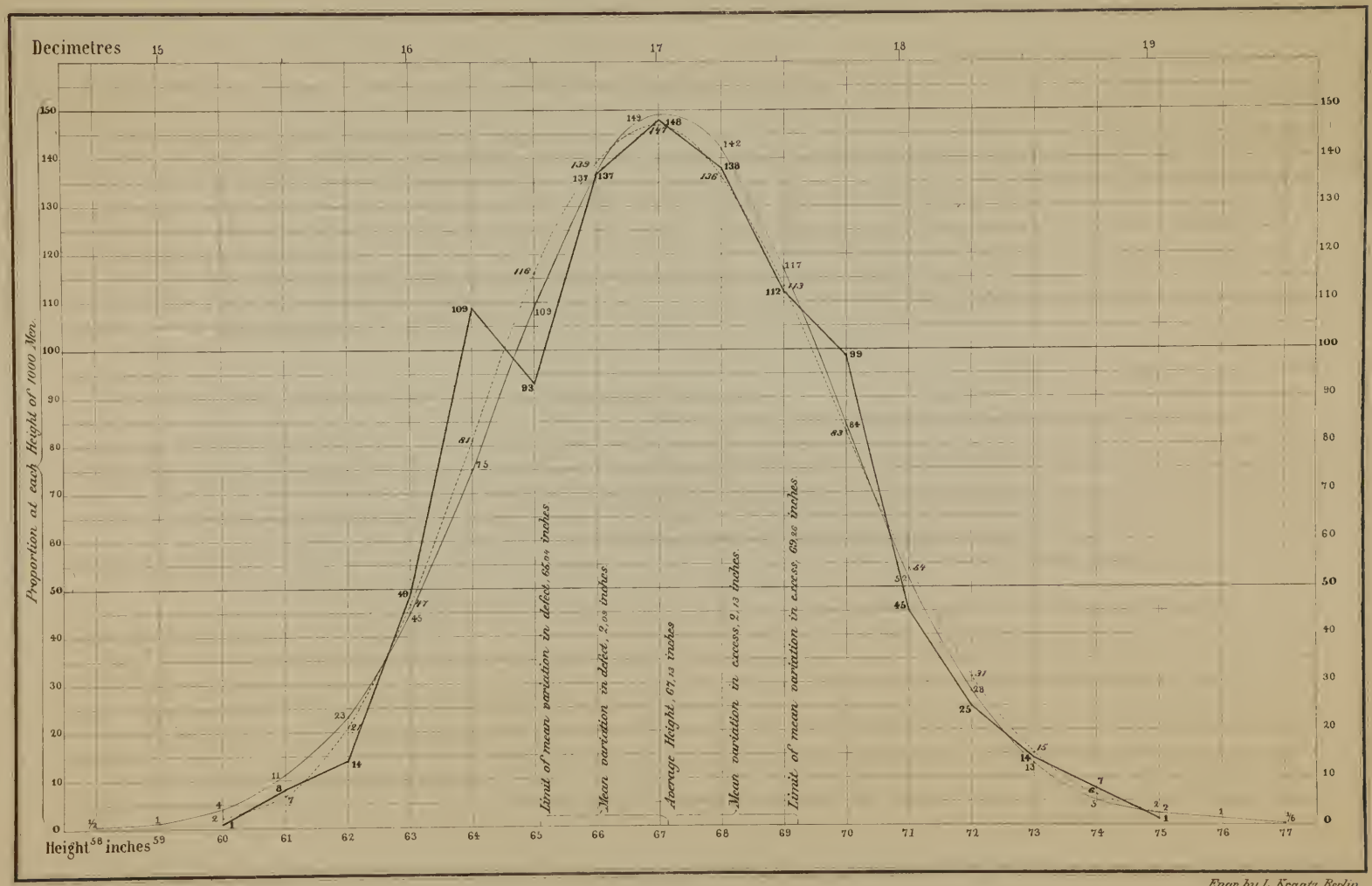
The Bold *Numbers denote the results of Observation, the* Light *those of Calculation.*

International Statistical Congress at Berlin, 1863.
On the Military Statistics of the United States of America.

Diagram C.

representing the **Distribution**, according to **Height**, of Soldiers in the Army of the Potomac; derived from Measurements of 761 men made under the direction of the **Sanitary Commission**, also, comparing these results of Observation with theoretical values calculated according to the Law of Distribution indicated by the mathematical Theory of Probabilities; and with an adjustment of the irregularities of the observed values.

The numbers are proportioned to the Basis of 1000 persons measured.



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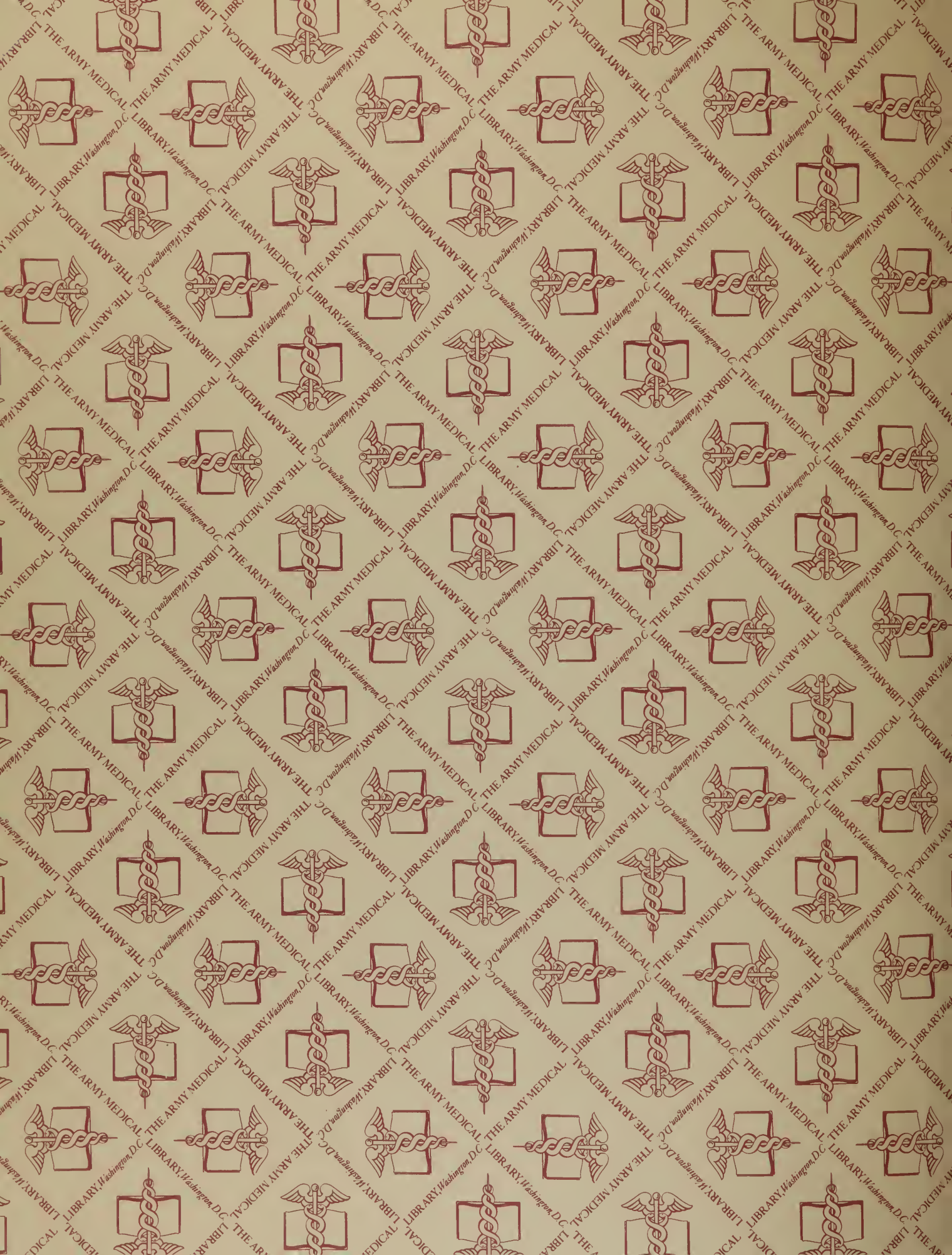
The Heavy line (——) connects points given by the actual measurements

The Light (– – –) and the Dotted (……) lines are continuous, and are each calculated from values, already tabulated, of the well-known expression $\frac{2}{\sqrt{\pi}} \int_0^t e^{-t^2} dt$. *In the construction of the former of these two curves, the first differences, and of the latter, the third differences, respectively, of* t *considered as a function of the height, were assumed to be constant.*

The **Bold**, *the* Light, *and the Italic numbers refer to the* **Bold**, *the* Light, *and the Dotted lines respectively.*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